US006112075A

United States Patent [19]

Weiser

[11] Patent Number: 6,112,075

[45] Date of Patent: Aug. 29, 2000

[54] **METHOD OF COMMUNICATING EMERGENCY WARNINGS THROUGH AN EXISTING CELLULAR COMMUNICATION NETWORK, AND SYSTEM FOR COMMUNICATING SUCH WARNINGS**

[76] Inventor: **Douglas Diedrich Weiser**, 623 Lakeview Rd., Lake St. Louis, Mo. 63367

[21] Appl. No.: **09/002,522**

[22] Filed: **Jan. 2, 1998**

Related U.S. Application Data

[63] Continuation of application No. 08/335,150, Nov. 7, 1994, abandoned.

[51] **Int. Cl.**[7] **H04Q 7/20**

[52] **U.S. Cl.** **455/404**; 455/521; 455/556; 455/557; 455/228; 340/539

[58] **Field of Search** 455/404, 466, 455/521, 38.1, 38.2, 31.2, 556, 557, 525, 227, 228, 344, 567; 340/825.44, 825.54, 539, 709, 601; 379/37, 39

[56] **References Cited**

U.S. PATENT DOCUMENTS

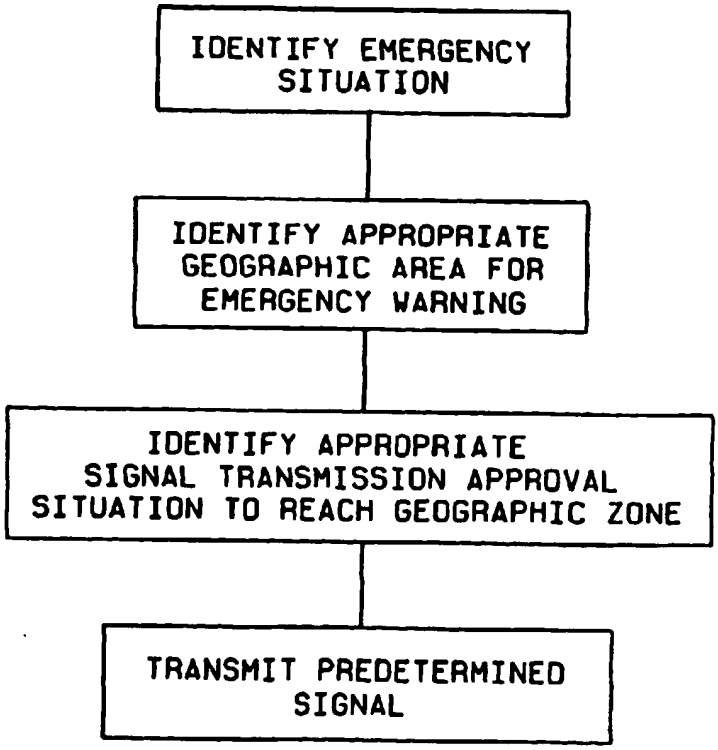
3,701,024	10/1972	Knowles et al.	455/526
4,415,771	11/1983	Martinez	379/43
4,435,843	3/1984	Eilers et al.	455/228 X
5,272,465	12/1993	Meares, Jr.	340/539
5,278,539	1/1994	Lauterbach et al.	340/539
5,444,433	8/1995	Gropper	455/526 X
5,448,618	9/1995	Sandlerman	455/404 X
5,533,094	7/1996	Sammugam	425/426

Primary Examiner—Fan Tsang
Assistant Examiner—Philip J. Sobutka
Attorney, Agent, or Firm—Howell & Haferkamp, LC

[57] **ABSTRACT**

A method of communicating emergency warnings to persons within a selected in a region served by a cellular communication system that comprises a plurality of transmission stations, includes providing persons in the area with warning devices that generate an emergency warning in response to a predetermined signal; identifying at least one transmission station in the communication system to transmit the predetermined signal to warning devices in the selected area; and transmitting the predetermined signal from the identified transmission station to cause warning devices in the selected area to generate emergency warnings. The system for implementing this method includes a plurality of warning devices disbursed throughout the area, and a device for identifying one or more signal transmission stations in the cellular communication network appropriate to transmit the predetermined signal to warning devices in the selected area, and causing the transmission stations identified to transmit the predetermined signal to cause warning devices in the selected geographic area to generate emergency warnings.

13 Claims, 2 Drawing Sheets



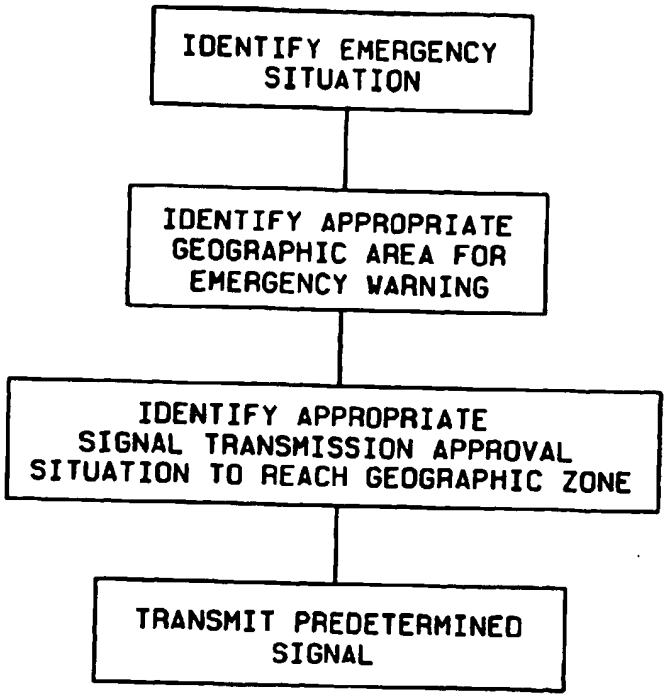

IDENTIFY EMERGENCY SITUATION
IDENTIFY APPROPRIATE GEOGRAPHIC AREA FOR EMERGENCY WARNING
IDENTIFY APPROPRIATE SIGNAL TRANSMISSION APPROVAL SITUATION TO REACH GEOGRAPHIC ZONE
TRANSMIT PREDETERMINED SIGNAL

FIG. 1

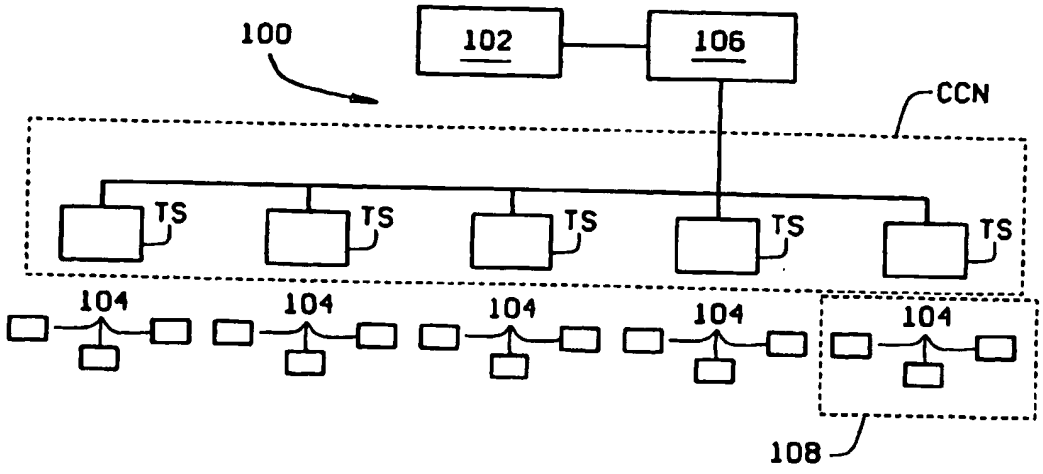

100
102
106
CCN
TS
TS
TS
TS
TS
104
104
104
104
104
108

FIG. 2

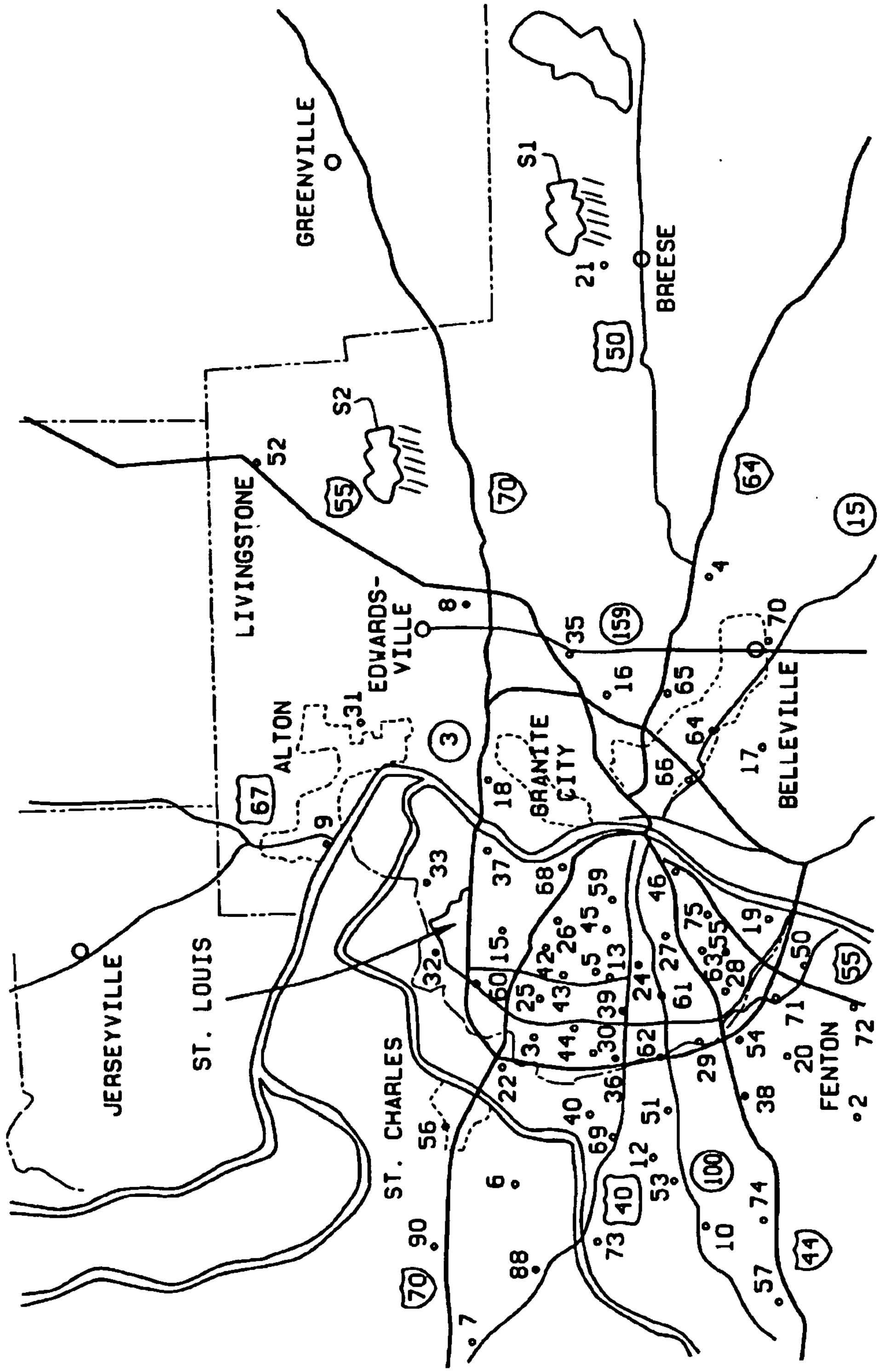

GREENVILLE
S1
BREESE
S2
LIVINGSTONE
EDWARDS-VILLE
ALTON
GRANITE CITY
BELLEVILLE
JERSEYVILLE
ST. LOUIS
ST. CHARLES
FENTON

FIG. 3

METHOD OF COMMUNICATING EMERGENCY WARNINGS THROUGH AN EXISTING CELLULAR COMMUNICATION NETWORK, AND SYSTEM FOR COMMUNICATING SUCH WARNINGS

This application is a continuation of application Ser. No. 08/335,150, filed on Nov. 7, 1994, and now abandoned.

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a method of communicating emergency warnings utilizing an existing cellular communication network, and a system for communicating such emergency warnings.

There are a number of situations where it is desirable to issue warnings to a broad audience in a selected geographic area. For example, in the case of severe weather, such as a tornado, it is desirable to warn persons in the areas affected so that they can seek shelter. In some areas, audible alarm systems are provided to warn residents of such weather emergencies. However, not everyone in the area can hear these warnings. Moreover, it is expensive to establish and maintain this elaborate system just for occasional use. Another example of a situation where it is desirable to issue an emergency warning to a broad audience in a selected geographic area is in the case of a nuclear power plant or a toxic waste handing site. In these situations, special radio receivers have been provided to persons in areas likely to be affected, and special transmitters provided to transmit warnings to those special receivers. Again, it is expensive to establish and maintain this type of elaborate system just for occasional use. Moreover, these systems are local by nature, and do not provide warnings to persons just passing through the area.

The present invention provides a method and system for communicating emergency warnings through an existing cellular communication network. Cellular communication networks, and in particular cellular telephone networks, now cover large portions of the United States. These networks comprise a plurality signal transmission stations distributed across a geographic region. The primary function of these networks is to facilitate communication by cellular telephones, and the systems are maintained for that purpose. Thus, the cost of establishing and maintaining a major portion of the system is already financed. The method of the present invention utilizes this established cellular communication network to communicate emergency warnings to a selected geographic area within the geographic region served by the network. According to this method, persons within the area are provided with warning devices that generate an emergency warning in response to a predetermined signal transmitted from one of the signal transmission stations in the cellular communication network. When an emergency situation occurs, at least one signal transmission station in the cellular communication network, appropriate to transmit the predetermined signal to warning devices in the affected geographic area, is selected. Then the predetermined signal is transmitted from the selected transmission station to cause warning devices in the selected geographic area to generate emergency warnings.

The emergency warning is thus selectively transmitted to those warning devices within a certain proximity of the selected transmission stations. By utilizing a preexisting cellular communication network, the only additional cost of implementing the method and system is the provision of warning devices, which can be relatively simple and inexpensive. By making these devices universal (which is only possible by using selected transmission stations), the cost can be reduced and the method and system can function to provide emergency warnings to persons merely passing through the geographic area affected by the emergency.

The method and system of the present invention improve the ability of emergency management agencies to reach the population. The method and system operate independently of regular telephone and electrical service, which can be compromised in emergency situations. The method and system reaches persons inside buildings where sirens might be difficult to hear and where televisions and radios may not be in operation.

The system is simple in construction and operation. The warning units are triggered by a common predetermined signal, and geographical selectivity is achieved by proximity to particular cellular transmission stations. This eliminates the need for geographic encoding of the warning devices, or programming units for specific locations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a flow chart of the method of the present invention;

FIG. 2 is a schematic diagram of the embodiment of a system for implementing the method of this invention; and

FIG. 3 is a map of a geographic region served by cellular communication network of the type utilized by the present invention, illustrating the operation of the method of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

According to the method of the present invention, persons within the geographic region to whom it would be desirable to communicate emergency warnings are provided with a warning device. In the case of weather warnings, the warning device might be provided to everyone in the region. In the case of nuclear power plants or toxic waste handling sites, the warning devices might only be provided to those persons in the region likely to be affected- by an emergency at such plants or sites.

The warning device is preferably a simple, inexpensive device that generates a emergency warning in response to receiving a predetermined signal. The emergency warning can be an audible alarm, a recorded or generated spoken warning, a visible warning, such as a flashing light, a tactile warning, such as a vibration or any combination thereof. The devices can all be made to be responsive to the same predetermined signal, and preferably are responsive to the same signal, the geographic selectivity of the emergency warning is controlled by controlling the transmission of the preselected signal. If all of the devices are responsive to the same signal, then a device can be used to receive signals in any area where the signal may be given. Thus, for example

if an automobile, truck, or train is carrying such a warning device, and traverses a geographic area where a warning is being communicated, then the persons in the automobile, truck, or on the train will likewise receive the emergency warning via the warning device.

Of course it is possible to make the warning device responsive to more than one preselected signal, and to have the warning device generate different specific emergency warnings in response to differing preselected signals. Thus it is possible to use this method and system to warn of varying degrees of emergency, or to warn of several different types of emergencies. For example, the method and system could be used to send an emergency warning of a severe weather alert, a severe weather watch, and a severe weather warning.

In the preferred embodiment the warning device has a 110 VAC standard grounded male three-prong plug flush mounted to the back of the device for wall mounting. The device would include a receiving antenna tuned to cellular frequencies. The antenna is preferably flexible and/or retractable. The device preferably includes a DC power supply to maintain a rechargeable back-up battery circuit.

In the preferred embodiment the warning device has an audible signal, similar to that in many home smoke alarms. However, the warning device should have a distinctive signal so that the warning signal is not confused with some other type of alarm. The warning device has suitable circuitry, whose design is well within the ability of a person of ordinary skill in the art, that recognizes a preselected "MINS" cellular signal, transmitted from one or more selected transmission stations in the cellular communication network. The device also has suitable circuitry, also within the ability of a person of ordinary skill in the art, responsive to recognition of the "MINS" cellular signals to generate the emergency warning.

When an emergency occurs, or is about to occur, affecting a particular geographic area, one or more transmission stations within the cellular communication net work are identified as appropriate to transmit the predetermined signal to warning devices in the selected geographic area. As a general rule, the identified transmission stations will be those closest to the selected geographic area. The preselected signal is then transmitted from the identified signal transmission station(s) to cause warning devices in the selected geographic area to generate emergency warnings.

Emergency management agencies or other authorities responsible for issuing emergency warnings can activate specific transmission stations, for example by ground line telephone and computer links. The system of this invention is readily adaptable to automation, for example, when a weather monitoring system identifies an emergency in a particular geographic area, a computer can automatically identify the cellular transmission stations appropriate for that particular geographic area, and automatically cause the appropriate transmission stations to transmit the preselected signal.

One embodiment of the method of the present invention is represented schematically in FIG. 1. In the first step, an emergency situation is identified. In the second step, the appropriate geographic area for the emergency warning is identified. In the third step, the appropriate signal transmission stations to reach the geographic area are identified. This can be done with a manual or automated look-up table, or geographically on a map, or otherwise. In the fourth step, the predetermined signal is transmitted from the identified transmission stations, thereby activating the warning devices in the vicinity of the identified transmission stations, and providing a warning to persons in proximity to the warning, device.

One possible implementation of the system of this invention is illustrated schematically in FIG. 2. The system **100** comprises a device **102** for automatically identifying a geographic area where an emergency situation exists. The system also comprises a plurality of warning devices **104** disbursed in the region. The warning devices **104** generate an emergency warning in response to a predetermined signal from a signal transmission station (TS) in a cellular communication network (CCN). The system also includes a device **106** that automatically identifies one or more of the signal transmission stations (TS) appropriate to transmit the predetermined signal and causes the identified signal transmission station to transmit the predetermined signal. The warning devices **104** within the transmission range of the signal transmission station are activated by the predetermined signal and provide an emergency warning to those persons in the vicinity of the warning devices. For example, if device **102** identified an emergency situation in area **108**, the device **106** would identify the signal transmission station (TS) **110** as appropriate to reach area **108**, and cause the signal transmission station **110** to send the predetermined signal. This actuates the warning devices **104** in the area **108**, but not the other warning devices, which are too remote from station **110** to react to the predetermined signals.

OPERATION

The operation of the method and system of the presents invention are best understood with reference to the FIG. **3** map. FIG. **3** is a map of a geographic region served by a cellular communication network comprising a plurality of signal transmission stations identified with one or two-digit numbers. According to the method of this invention, if a storm was identified at S1, the signal transmission station **21** would be identified as appropriate to generate the predetermined signal to warning devices in areas affected by the storm. The predetermined signal would then be transmitted from signal transmission station **21**, causing warning devices in the vicinity of the station and in the vicinity of the storm at S1, to generate emergency warnings. Similarly, if a storm were identified at S2, the signal transmission stations **8** and **52** might be identified as appropriate to generate the predetermined signal to warning devices in areas affected by the storm. The predetermined signal would then be transmitted from signal transmission stations **8** and **52**, causing warning devices in the vicinity of those stations and the vicinity of the storm at **52** to generate an emergency warning.

The method and system of the invention can also be coupled with radio broadcast technology. For example, a warning device can be incorporated into a car, and coupled to the car radio such that when the warning device is triggered by the predetermined signal, the warning device tunes the radio, or if the radio is not on it turns on and tunes

the radio to an appropriate station. It is presently known to incorporate station identifying signals in radio broadcasts, an it is further known to provide radios capable of identifying these station identifying signals and automatically tune to stations with particular identifying signals.

Thus, the warning device could cause the car radio to tune to a radio station with particular identifiers which station broadcasts appropriate warning messages. While this can be adopted for home or institutional use, it is particularly appropriate for use in vehicles, because the persons in vehicles are likely to be strangers to the area, and may not otherwise know what to do if just a simple alarm is given.

What is claimed is:

1. A method of communicating emergency warnings to persons within a selected geographic area within a geographic region served by an existing cellular communication system that comprises a plurality of signal transmission stations, the method comprising:

providing a plurality of warning devices within the geographic region;

identifying one or more, but less than all, of the plurality of transmission stations in the cellular communication system appropriate to activate warning devices in the geographic area; and

transmitting a predetermined signal from the identified transmission station or stations to activate all the active warning devices in the geographic area of the geographic region, which warning devices generate emergency warnings in response to the predetermined signal.

2. The method of communicating emergency warnings according to claim 1, wherein the method comprises transmitting one of several predetermined signals, and wherein the warning devices generate different warnings depending upon what predetermined signal is transmitted.

3. The method of communicating emergency warnings according to claim 1 wherein the warning devices are coupled with a radio receiver, and automatically tune the radio receiver to a radio station in response to the predetermined signal.

4. A method of communicating emergency warnings to persons within a selected geographic area within a geographic region served by an existing cellular communication system that comprises a plurality of signal transmission stations, the method comprising:

providing a plurality of warning devices in the geographic region, which warning devices generate an emergency warning in response to a predetermined signal transmitted from one of the signal transmission stations;

identifying at least one signal transmission station in the cellular communication system, but less than all of the transmission stations of the plurality of signal transmission stations in the cellular communication system, appropriate to transmit the predetermined signal to the warning devices in the selected geographic area;

transmitting the predetermined signal only from the identified signal transmission station or stations to cause all the active warning devices in the selected geographic area to generate emergency warnings.

5. The method of communicating emergency warnings according to claim 4 wherein the warning devices generate different warning signals in response to different predetermined signal transmitted from one of the signal transmission stations; and wherein the step of transmitting the predetermined signal comprises selecting from several predetermined signals, a predetermined signal that will cause the warning devices to generate an appropriate warning signal.

6. The method of communicating emergency warnings according to claim 4 wherein the warning devices are coupled with a radio receiver, and automatically tune the radio receiver to a radio station in response to the predetermined signal.

7. A method of communicating emergency warnings to persons within a selected geographic area within a geographic region served by an existing cellular communication system that comprises a plurality of signal transmission stations, the method comprising:

providing a plurality of warning devices in the geographic region, which warning devices generate an emergency warning in response to a predetermined signal transmitted from one of the signal transmission stations;

identifying a selected geographic area where an emergency warning should be communicated to the persons in the area;

identifying at least one signal transmission station in the cellular communication system, but less than all of the transmission stations of the plurality of signal transmission stations in the communication system, appropriate to transmit the predetermined signal to the warning devices in the selected geographic area;

transmitting the predetermined signal only from the identified signal transmission station to cause all the active warning devices in the selected geographic area to generate emergency warnings.

8. The method of communicating emergency warnings according to claim 7 wherein the warning devices generate different warning signals in response to different predetermined signal transmitted from one of the signal transmission stations; and wherein the step of transmitting the predetermined signal comprises selecting from several predetermined signals, a predetermined signal that will cause the warning devices to generate an appropriate warning signal.

9. The method of communicating emergency warnings according to claim 7 wherein the warning devices are coupled with a radio receiver, and automatically tune the radio receiver to a radio station in response to the predetermined signal.

10. A system for communicating emergency warnings to persons within a selected geographic area within a geographic region served by an existing cellular communication system that comprises a plurality of signal transmission stations, the system comprising:

a plurality of warning devices in the possession of persons within the geographic region, the warning devices generating an emergency warning in response to a predetermined signal transmitted from a signal transmission station in a cellular communication network;

a device for identifying one or more signal transmission stations in the cellular communication system, but less than all of the plurality of signal transmissions stations in the cellular communication system, appropriate to transmit the predetermined signal to the warning devices located within the selected geographic area, and causing the transmission stations identified to transmit the predetermined signal to cause all the active warning devices in the selected geographic area to generate emergency warnings.

11. The system according to claim 10 wherein the warning devices are coupled with a radio receiver, and automatically tune the radio receiver to a radio station in response to the predetermined signal.

12. A system for automatically identifying emergency situations and communicating emergency warnings to persons within a selected geographic area within a geographic region served by an existing cellular communication system that comprises a plurality of signal transmission stations, the system comprising:

a device for automatically identifying a geographic area where an emergency situation exists;

a plurality of warning devices in the possession of persons within the geographic region, the warning devices generating an emergency warning in response to a predetermined signal transmitted from a signal transmission station in a cellular communication system;

a device for automatically identifying one or more signal transmission stations in the cellular communication system, but less than all of the plurality of signal transmission stations system in the cellular communication system, appropriate to transmit the predetermined signal to all the warning devices in the selected geographic area, and causing only the transmission stations identified to transmit the predetermined signal from the identified signal transmission station to cause the active warning devices in the selected geographic area to generate emergency warnings.

13. The system according to claim 12 wherein the warning devices are coupled with a radio receiver, and automatically tune the radio receiver to a radio station in response to the predetermined signal.

* * * * *

US006463273B1

(12) **United States Patent**
Day

(10) **Patent No.: US 6,463,273 B1**
(45) **Date of Patent: Oct. 8, 2002**

(54) **WIRELESS WARNING SYSTEM**

(76) Inventor: **J. Cameron Day**, 2110 Glenridge Ct., Marietta, GA (US) 30062

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/309,528**

(22) Filed: **May 11, 1999**

(51) **Int. Cl.**[7] **H04M 11/00**

(52) **U.S. Cl.** **455/404**; 455/456; 379/37; 340/825.37

(58) **Field of Search** 455/404, 414, 455/3.06, 456; 340/825.44, 825.54, 825.37, 825.38, 7.1, 7.2, 573.1; 379/37, 49

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,603,951 A		9/1971	Bracken et al.	340/539
3,753,117 A		8/1973	Downing et al.	325/364
4,153,881 A		5/1979	Permut et al.	325/64
4,155,042 A	*	5/1979	Permut et al.	455/404
4,812,825 A		3/1989	Kennedy et al.	340/601
4,887,291 A	*	12/1989	Stillwell	455/404
5,278,539 A	*	1/1994	Lauterbach et al.	340/825.44
5,444,433 A		8/1995	Gropper	340/601
5,481,254 A		1/1996	Gaskill et al.	340/825.52
5,588,038 A		12/1996	Snyder	379/57
5,628,050 A		5/1997	McGraw et al.	455/12.1
5,742,235 A		4/1998	Miche'	340/690
5,745,849 A	*	4/1998	Britton	455/404
5,781,852 A		7/1998	Gropper	455/227
5,923,731 A	*	7/1999	McClure	455/404
5,995,553 A	*	11/1999	Crandall et al.	455/404
6,112,074 A	*	8/2000	Pinder	455/404
6,112,075 A	*	8/2000	Weiser	455/404

FOREIGN PATENT DOCUMENTS

DE	197 20 591	11/1998	G04G/1/00
JP	10-164634	10/1998	H04Q/7/14

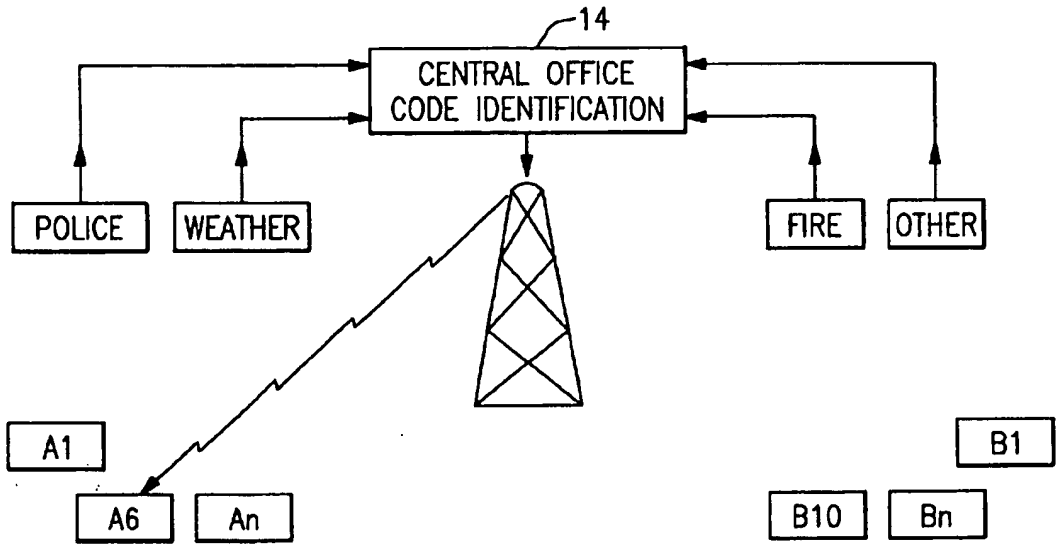
* cited by examiner

Primary Examiner—William Trost
Assistant Examiner—Simon Nguyen
(74) *Attorney, Agent, or Firm*—Bernstein & Associates, P.C.; Jason A. Bernstein

(57) **ABSTRACT**

A wireless warning system for alerting and advising selected uses of a potential or existing emergency within a predetermined geographic area. The system operates on the principle of a common or party-line pager communication link, where all users within the predetermined geographic area are alerted simultaneously of the emergency situation. When the system is activated a detectable alarm, in the form of an LED readout panel for portable pager receivers, or as an audio or visual alarm for fixed structures, alerts all users in the geographic area.

7 Claims, 2 Drawing Sheets



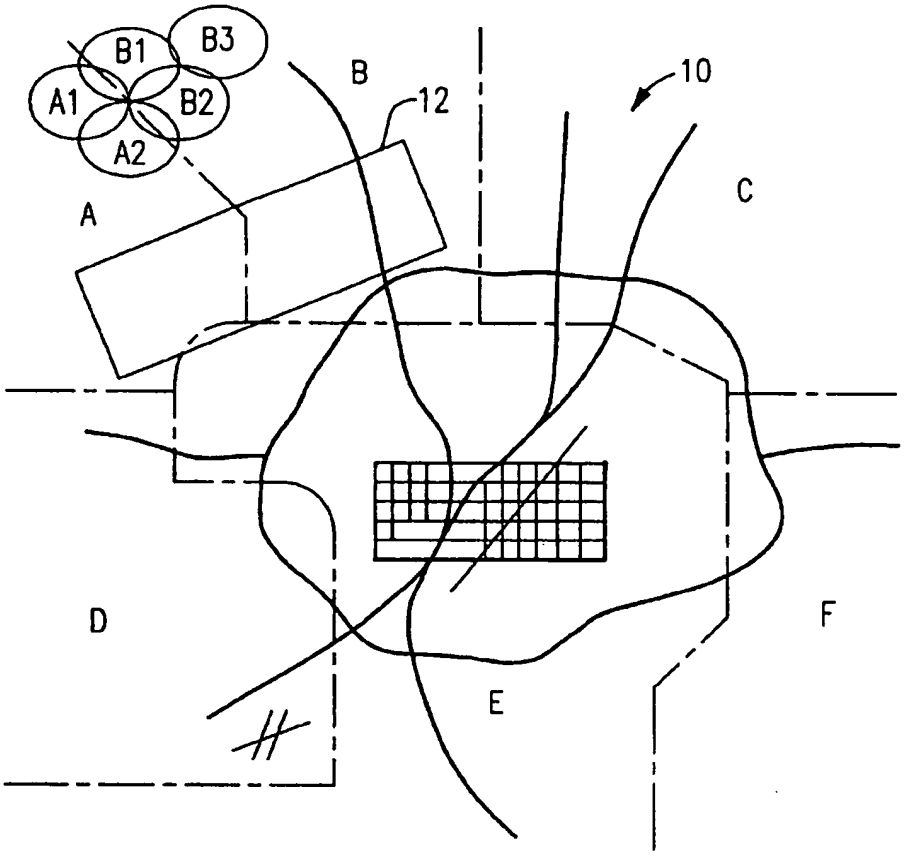


FIG.1

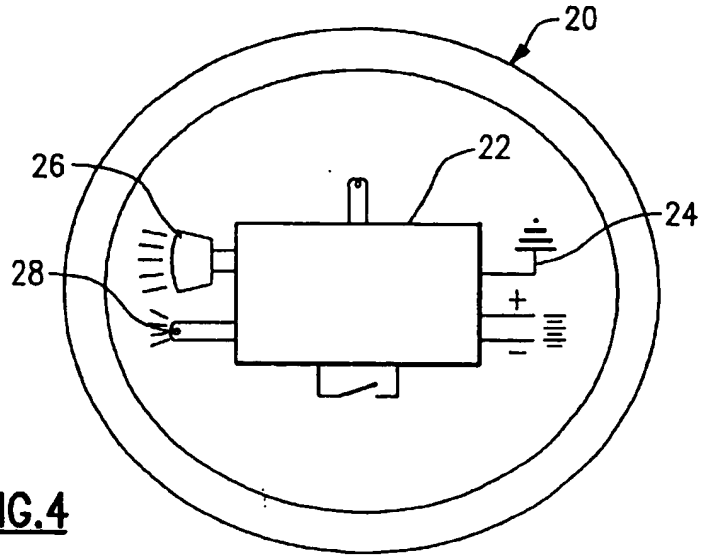


FIG.4

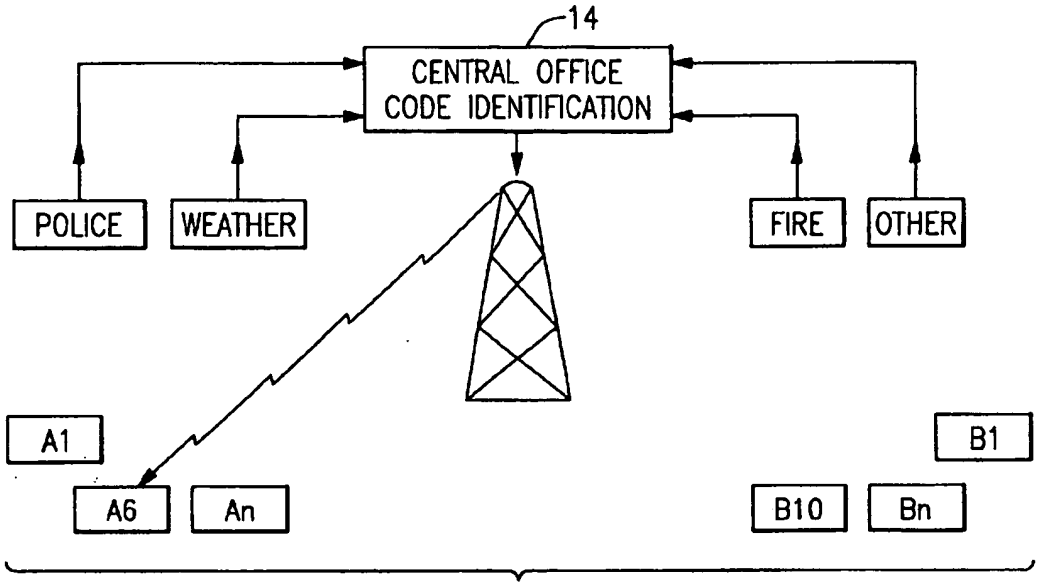

14
CENTRAL OFFICE
CODE IDENTIFICATION
POLICE
WEATHER
FIRE
OTHER
A1
A6
An
B1
B10
Bn

FIG.2

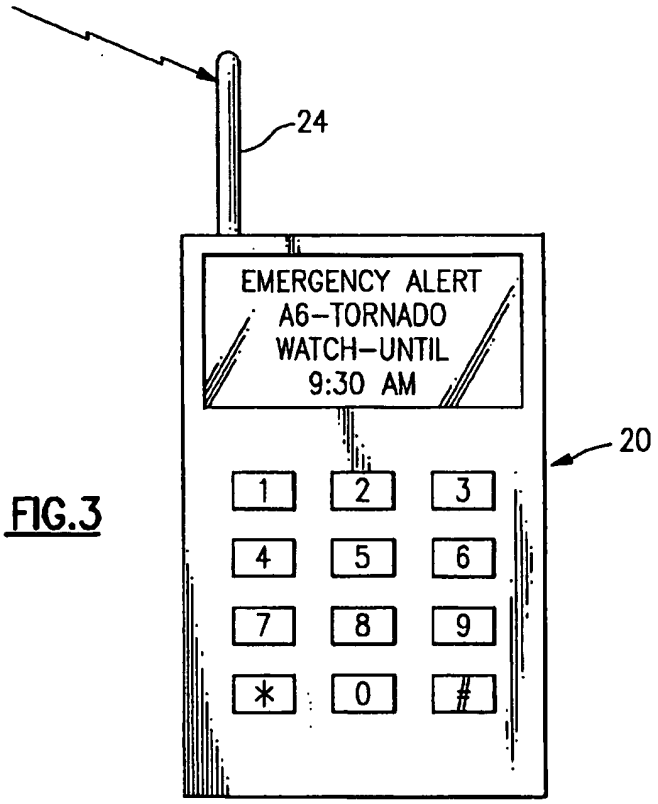

24
EMERGENCY ALERT
A6–TORNADO
WATCH–UNTIL
9:30 AM
20
1
2
3
4
5
6
7
8
9
*
0
#

FIG.3

WIRELESS WARNING SYSTEM

FIELD OF THE INVENTION

The present invention is directed to the field of wireless warning systems for rapidly warning selected system users, via a pager communication link, of various types of emergencies, particularly as a rapid and broad instantaneous system for a group of individual users, where a critical emergency may be a tornado warning or watch.

BACKGROUND OF THE INVENTION

The present invention relates to a system for providing warning information to users, such as to a pager-type system, or similar receiver, where rapidly transmitted emergency information can be critical in helping to avoid a potentially dangerous situation.

Most people today must rely upon the mass media, such as television and radio, to advise them of various emergency situations. These emergency situations vary from daily traffic reports, to more serious situations, such as hurricanes, tornadoes, plane crashes, chemical and plant accidents, etc. Unfortunately, one must be listening or watching to be aware of the specific emergency. Even where the emergency occurs at a fixed facility, such as a plant or prison, one must be within earshot to hear any alarm that may be sounded by the facility.

Despite the strides that have been made by the National Weather Service in determining areas of potential concern for tornadoes, through satellite technology and computer modeling, tornadoes continue to be emergencies that cause unfortunate injury and death throughout the United States and other countries each year. As good as those efforts have been in recent years, the problem exists in notifying the public. Unless one is listening to a radio or television, one might not even be aware of a "watch," much less a "warning." Clearly, when one is asleep, an advanced alert is impossible.

U.S. Pat. No. 5,278,539, to Lauterbach et al., represents a proposed solution to provide an alerting and warning system for alerting or warning large numbers of people of the occurrence or threat of an emergency using available communications media. Multiple facilities are monitored for the occurrence of multiple alarm conditions. On the occurrence of such a condition, radio or telephone contact is made with a Local Emergency Planning Committee (LEPC) and the LEPC is notified of the site and nature of the alarm condition. Using a predetermined listing or data bank the LEPC selects a number corresponding to the site and condition and transmits such number to an automated controller for a radio transmitter. The transmitter may be part of an existing radio paging system. The automated controller, on the basis of the number dialed in by the LEPC, transmits an appropriate Code Assignment plan (Cap Code) signal. The Cap Code signal is the electronic signature of a preprogrammed Cap Code chip within individual radio receivers positioned at the sites of intended alarm recipients. The Cap Codes are individually assigned and utilized to effect the notification of predetermined individuals related to specific alarm conditions. Upon a receiver being actuated by receipt of its Cap Code an alarm is actuated to produce a sensory alarm signal such as sound or light. A detector is provided at the alarm site and upon detecting the sensory alarm acknowledges to the monitored facility the occurrence of the alarm.

There are limitations, however, to the system of Lauterbach et al. The Lauterbach et al. system relies upon individual pager units, with each such unit to be called. That is, whether the pager units are called one by one, or as part of a pre-programmed list that is auto dialed by computer, the system thereof still requires dialing all of the individual numbers of the respective pager units. With electrical power lost, individual dialing would be of no real value as a warning system.

U.S. Pat. No. 5,588,038, to Snyder, teaches a more recent wireless system for communicating with a remote location, such as an automobile. The system thereof includes a calling transceiver, a central transceiver, and a satellite, whereby the calling transceiver and the central transceiver are used to transmit a forward wireless communication over-the-air, through the satellite, and to a pager transceiver located in the remote location in order to control a device located in the remote location. Upon receiving the signal, the pager transceiver generates a first signal, which is received by a tripping circuit, which in turn generates a second signal. The second signal causes a switch to trip, which thereby controls the device located at the remote location. The pager transceiver also has the capacity to transmit reverse wireless communications through the satellite, which allows monitoring of the device. This is at best an alarm system for tracing a stolen car, for example, but it is not an effective means for alerting a person of an emergency.

The invention hereof is uniquely distinctive by the ability to provide simultaneous emergency warning information to selected users of a wireless pager or related type system, where such information may be rapidly and automatically transmitted to such users within a designated geographic area served by the service provider. The manner by which this invention provides this unique warning alert will become apparent to those skilled in the art from the following description, particularly when read in conjunction with the accompanying drawings.

SUMMARY OF THE INVENTION

The present invention relates to a wireless warning system to alert and advise selected users to potential or existing emergencies within a geographic area covered by a service provider, where the system operates on the principle of a common or party-line pager communication link. The system comprises a user program in which each selected user has a coded party-line number that is activated by an emergency agency to alert said user of the emergency. The service provider, in communication with various emergency detection stations, such as police, fire, weather, etc., receives the emergency information regarding the geographic area for the emergency, and transmits the information simultaneously to all users. By this system the users are quickly advised of an emergency at a location, i.e., permanent home, mobile home, office, or school, or other location as more clearly defined hereafter.

An alternative use of the system hereof may be as a rapid means to simultaneously notify a group of users, such as a group of children at a large theme park, military personnel theater or plant supervisory personnel to assemble at a given location, or the like.

Accordingly, an object of this invention is to provide a system for alerting and advising users thereof of an emergency, when the user does not have the ready convenience of a mass media source of information.

A further object hereof is a warning system that can delineate and accurately define the nature and severity of an emergency.

Another object of this invention lies in the ability to simultaneously alert all users of the system within the geographic area where the emergency is located.

Still another object hereof lies in its use in non-emergency situations, where a selected group of individuals may be alerted simultaneously to assemble at a particular location, such as a group of children at a theme park, or plant officials for an important meeting.

A further object of this invention is a wireless communication system that can utilize conventional wireless receivers or systems, such as pager transmission companies to pager-type receivers, pager units, or fixed alarm devices.

These and other objects will become more apparent to those skilled in the art from the following description, particularly when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

The invention is illustrated in the drawings in which like reference characters designate the same or similar parts or features throughout the several views of which:

FIG. **1** is a representation of a typical geographic area to be covered by a first operating mode for the wireless warning system of the present invention, where the geographic area may be a series of adjoining zip code areas, as known in the art, within a metropolitan area covered by the system hereof;

FIG. **2** is a pictorialized diagram of the system of the present invention, illustrating an exemplary first operating mode thereof;

FIG. **3** is a cutaway view of a device for generating a detectable alarm for a fixed structure within an alert of the geographic area, such as a home, school, or occupied public or private building, in response to an electronic signal from an emergency notifier, in accordance with the first operating mode of the present invention; and

FIG. **4** is a plan view of a typical wireless pager-type receiver, illustrating a detectable alarm in the form of an LCD message on said receiver, in accordance with the second operating mode of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is directed to a pager-type communication system that operates on the principle of a common coded signal, or party-line, for all users of the system within a prescribed geographic area. Within this mode of operation there are two principal applications for the system: (a) a means to rapidly and simultaneously warn all users thereof of an emergency, such as a tornado watch or warning, and (b) as a means to quickly and simultaneously notify such users of an impending event.

While the first operating mode for the system hereof relies upon a pager service provider, such as a phone company, there would be no user fees to the ultimate user of the service, thus making the system quite unique. If a fee were required, it would be the responsibility of the government agency which would notify the users of an emergency, such as the Emergency Management System (EMS). At best, only a small fee would be required as the system utilizes a common pager number. The signal is a common signal similar to an AM or FM radio signal. As with radio, one does not have to buy air time or subscribe to any service, one simply purchases a radio receiver and can receive all the signals broadcast in the local or geographic area. The pager-type receiver, as employed in this invention, and as explained in more detail hereafter, is similar. That is, one simply purchases a pager-type receiver that is already programmed for the geographic area of concern, such as the purchaser's zip code area, then the unit is mounted on a wall, for example, ready to be activated. This will become clearer in the following description.

Turning now to the drawings, FIG. **1** illustrates at least a portion of an exemplary geographic area **10** that may be applicable to the first operating mode of this invention. Overlaid on the geographic area **10** is an elongated path **12** that may represent the projected path of a tornado, as determined by The National Weather Service and transmitted to the local EMS. It will be understood that the geographic area may be defined differently to more aptly describe the local layout. If zip code areas are too large for a meaningful use of the system hereof, such areas may be subdivided into smaller zones. Alternately, existing county lines may be used.

FIG. **2**, in conjunction with FIG. **1**, best illustrates the operation of the first operating mode of the system of this invention, whereas FIG. **3** illustrates a preferred pager-type receiver that may be incorporated into said system in fixed structures, such as permanent homes, mobile homes, schools, occupied buildings, etc. Alternatively, instead of a pager a pager/cellular phone or a personal communication system can be used.

The National Weather Service, (NWS) constantly monitors the weather throughout the United States, and is particularly active during hurricane and tornado seasons. Further, the monitoring is particularly refined through years of experience and computer modeling. Despite the technology breakthroughs, tornadoes remain a natural disaster that continue to cause many injuries and fatalities in Southern and Midwestern areas of the United States.

Local EMS agencies, where the numeral **14** designates the EMS for the geographic area **10**, are in communication with the NWS. As tornadoes are highly possible a "watch" is noted, such as for the path **12** (FIG. **1**), where the EMS may simply dial one or two coded numbers, depending on the coverage area of said path relative to one or two zip code areas, to alert all users (A-1) to (A-n) that a "watch" is in place. Subsequently, if the "watch" has to be upgraded to a "warning," a second coded call will be made to the users (A-1) to (A-n) to alert them that a "warning" is now in place and protective cover is appropriate for everyone at the location. However, since tornadoes can move rapidly, it may be necessary to designate a "watch" for a different zip code area, such as users, (B-1) to (B-n). However, since this can be accomplished by a single coded call, the users are quickly and simultaneously advised of the "swatch."

Since the primary purpose of the first operational mode for the system hereof is to warn and alert people in fixed structures, a conventional and expensive, mobile pager receiver is neither used nor necessary. A feature of the present invention is the provision of an economical receiver that is affordable by most people. One such receiver is illustrated in FIG. **3**. The device **20** is sized like a typical "smoke alarm" and may include a pager circuit **22** in communication through an antenna **24** with the service provider, more specifically the EMS, and at least a pair of detectable alarm means. In the embodiment of FIG. **3**, one such alarm means may be high level horn **26**, i.e., 85 dB, and a flashing light **28**. By incorporating plural alarm means, it is possible to readily categorize the nature of an emergency. For example, the light may flash in response to a first coded signal to advise of a tornado "watch", whereas the horn may be sounded as the result of a second coded signal to advise of a tornado "warning", and hence the need to seek protective cover.

The alternate or second operating mode for the system of this invention, while still operating on the principle of a common pager communication link, may be for essentially private use. For example, there may be interest for the system at a theme park, such as Disney World, where it is common for large groups to visit. The group would work in conjunction with the theme park, where the theme park management may provide, on loan, a number of pager receivers to be used by chaperons or subgroup leaders. Each subgroup would be provided a pager receiver, with a common coded number, where the overall group leader, functioning like the EMS in the first operating mode, may simultaneously contact and advise all subgroup leaders, through a pager communication link operated by the theme park, on information pertinent to the full group. The pager receivers, where an exemplary receiver is shown in FIG. 4, may include an LED panel on which the information may appear. The message may be merely a reminder of "lunch" or "departure,", or it may be an emergency situation involving a group member. Particularly in large theme parks, where it may be difficult to keep a large group together, such a system offers a degree of comfort that simultaneous contact with the entire group is possible at all times.

Another area of private interest for the system hereof is as a simultaneous paging system for a large business plant or complex, where it may be necessary to summons key personnel to an important meeting, for example. This system would avoid the need to individually dial and contact the key personnel in question.

Moreover, military, firemen, emergency response teams (e.g., SWAT teams) may all benefit from a simultaneous command signal (e.g., need to retreat/regroup) being sent over a large or small area. The present invention provides a rapid, inexpensive and direct system for achieving this result.

Although only a few exemplary embodiments of this invention have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the following claims. In the claims, means plus function claims are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Thus although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas a screw employs a helical surface, in the environment of fastening wooden parts, a nail and a screw may be equivalent structures.

It should further be noted that any patents, applications or publications referred to herein are incorporated by reference in their entirety.

I claim:

1. A one-way wireless pager warning system for alerting and advising selected users of a potential or existing emergency within at least one predetermined geographic area, said system comprising:

a) a distinct common pager communication link communicating with plural pager receivers programmed to a common coded address for each said geographic area;

b) at least one detection station for receiving said information regarding said emergency;

c) a central receiving station for receiving and monitoring said information and identifying at least one said area associated with said emergency;

d) means for selectively and simultaneously transmitting a single coded electronic signal from said central receiving station to all said users within said area, where said users are subscribers to said common pager communication link with the same coded address; and,

e) means for generating a detectable alarm in response to said coded electronic signal to said users, where said alarm further categorizes the nature of the emergency.

2. The wireless warning pager system of claim 1, wherein said geographic area may be subdivided into plural zones, with each said zone being individually and uniquely identified by a different specific coded pager communication link.

3. The wireless pager communication system of claim 2, wherein each said pager communication receiver includes the capability for said user to program said receiver to a second precoded address for a second said geographic zone.

4. The wireless warning pager system of claim 1, wherein said emergency may be weather related, and is further categorized into the nature of said emergency.

5. The wireless warning pager system of claim 1, wherein said means for generating said detectable alarm includes a fixed unit having plural alarm systems, where each said alarm system is used to identify a specific emergency.

6. The wireless warning pager system of claim 5, wherein said plural alarm system may include a combination of a combination of a flashing light and an audio sounding means.

7. A wireless pager communication system for simultaneously alerting a selected group of individuals, located within a prescribed geographic area, of an event or emergency within said geographic area, said system comprising:

a) a plurality of pager-type receivers programmed to the same coded address, each said receiver being assigned to a respective said user;

b) an alerting station having a pager communication link to each pager-type receiver, where said pager communication link utilizes a common code for all said receivers;

c) means for activating said pager communication link, through said alerting station, by the selective transmission of a coded electronic signal to all said receivers having the same coded address; and,

d) means for generating a detectable notice in all said receivers in response to said coded electronic signal, where said notice identifies said event or emergency.

* * * * *

US 20010041552A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2001/0041552 A1

Wingren et al. (43) Pub. Date: Nov. 15, 2001

(54) METHOD AND APPARATUS IN A MOBILE COMMUNICATIONS NETWORK

(75) Inventors: Tord Wingren, Malmo (SE); Mats Lindoff, Lund (SE)

Correspondence Address:
Gerald T. Welch
Jenkens & Gilchrist, P.C.
3200 Fountain Place
1445 Ross Avenue
Dallas, TX 75202-2799 (US)

(73) Assignee: TELEFONAKTIEBOLAGET L M ERICSSON

(21) Appl. No.: 09/732,204

(22) Filed: Dec. 7, 2000

(30) Foreign Application Priority Data

Dec. 10, 1999 (SE) 9904524-7

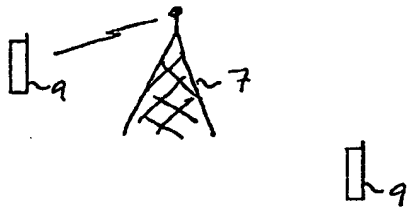
Publication Classification

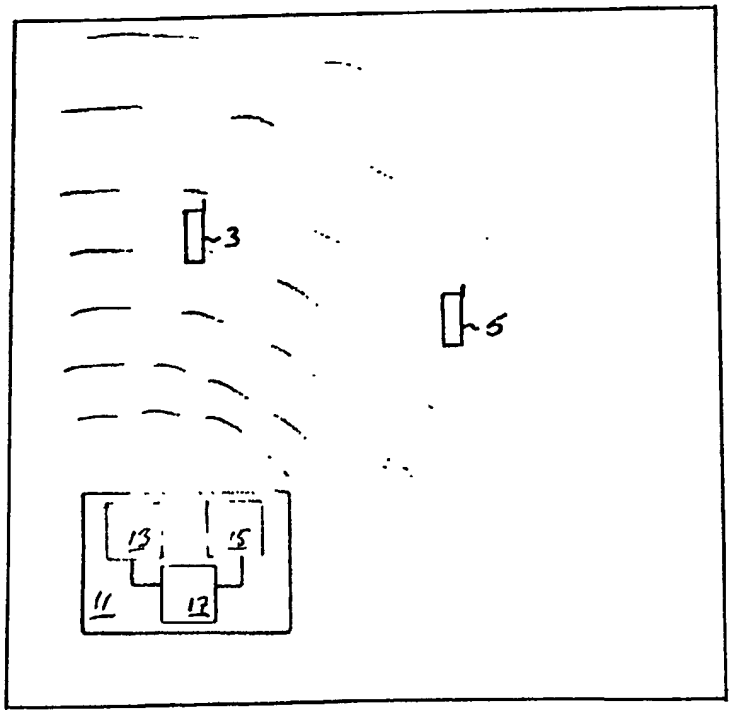
(51) Int. Cl.[7] H04B 1/00

(52) U.S. Cl. 455/404; 455/68; 455/69; 455/70; 455/421

(57) ABSTRACT

To detect and/or prevent the use of radio communication equipment in situations or places in which such use is undesirable, according to the invention a short-range radio communication unit may be used to detect portable radio communications unit in the vicinity and transmit to any such units that are turned on, either a command to turn them off or a message to the bearer of the phone. The telephone also comprises a short-range radio communications unit for this purpose.





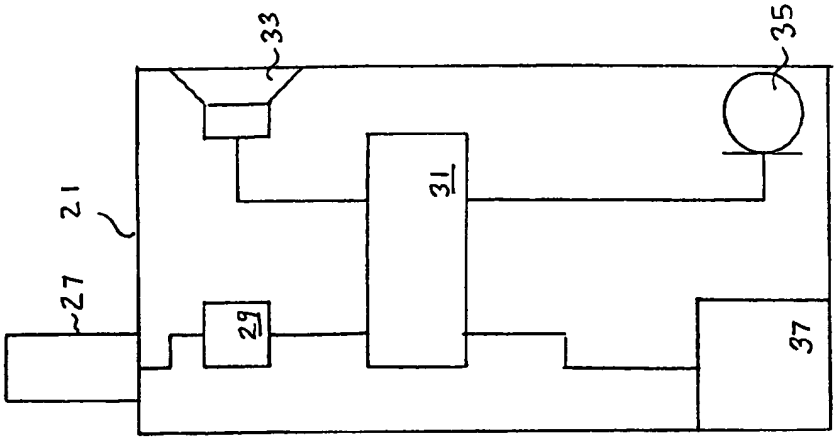


Fig. 2

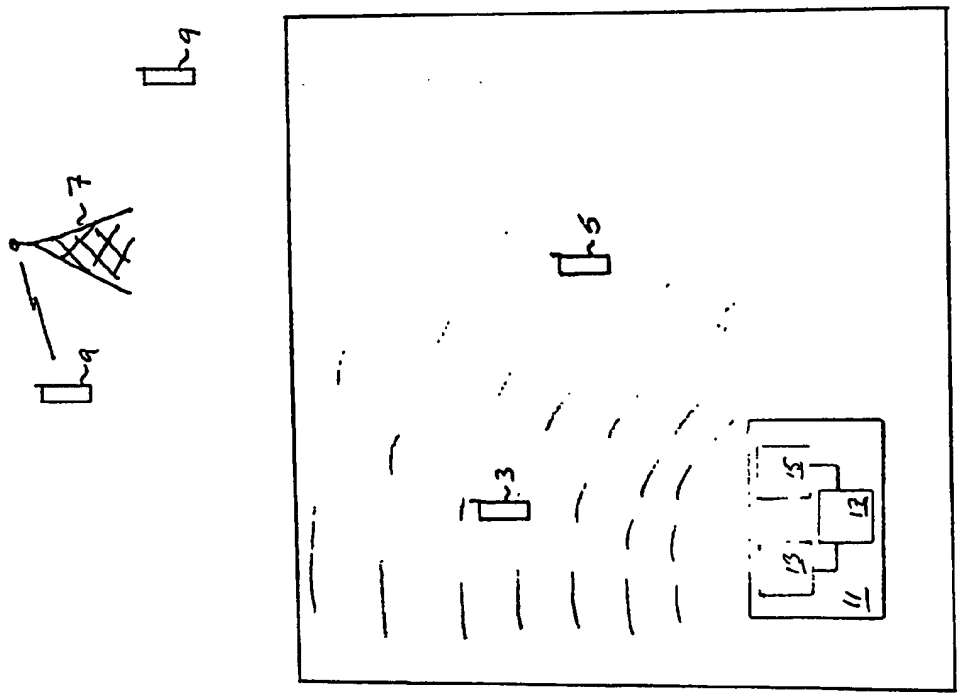


Fig. 1

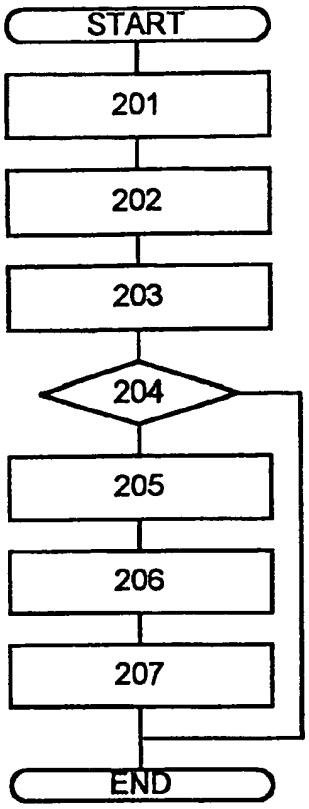

START
201
202
203
204
205
206
207
END

Fig. 3B

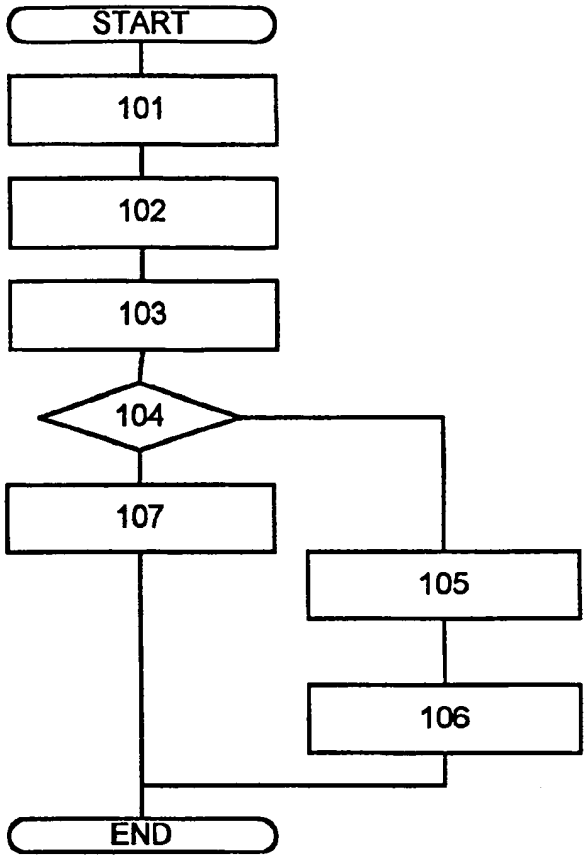

START
101
102
103
104
107
105
106
END

Fig. 3A

METHOD AND APPARATUS IN A MOBILE COMMUNICATIONS NETWORK

TECHNICAL FIELD

[0001] The present invention relates to mobile telephones an in particular to a method and an apparatus for preventing use of mobile telephones in situations where it is undesirable.

DESCRIPTION OF RELATED ART

[0002] Mobile telephones and other terminals utilizing wireless communication, such as personal computers, are being used to an increasing extent. In some cases this is very annoying to other people, for example, telephones ringing during concerts or at cinemas. Some times the owner of the phone even answers and engages in a conversation without leaving the room.

[0003] In hospitals, for example, radio signals transmitted by mobile telephones sometimes interfere with technical equipment. In airplanes all use of equipment containing radio transmitters is prohibited because they may interfere with the control electronics. Even in these situations, people sometimes ignore the ban on this type of equipment, or just forget to turn their mobile telephones off when entering an air plane or hospital area, or a concert hall or the like.

[0004] Patent specifications WO 96/29687 and U.S. Pat. No. 5,543,779 both describe methods for detecting any mobile telephones nearby that are engaged in communication with a base station. With this method, only a few of the mobile telephones present will be detected, and they will be so at a stage when the mobile telephone is already transmitting signals to the base station. This means that sensitive equipment may already be disturbed and it is probably too late to stop the telephone from ringing.

OBJECT OF THE INVENTION

[0005] It is an object of the invention to enable the detection and/or prevention of the use of radio communication equipment in situations or places in which such use is undesirable.

SUMMARY OF THE INVENTION

[0006] This object is achieved according to the invention by a first radio communication device adapted to

[0007] transmit a radio signal instructing other radio communication devices within a certain range from the unit to identify themselves;

[0008] receive and interpret the response signals; and,

[0009] in dependence of the response signal received from each radio communication device:

[0010] transmit a message to the radio communication device

[0011] transmit a message to the user of the radio communication device, or

[0012] order the radio communication device to turn itself off.

[0013] The object is also achieved by a portable radio communication device comprising means for communicating in a cellular telephone network and low power radio communication means

[0014] characterized in that it comprises means for

[0015] in response to a low power radio message instructing it to identify itself, transmitting a response signal;

[0016] receiving a message and/or instructions and act upon them.

[0017] The object is also achieved according to the invention by a method of controlling the use of mobile terminals, comprising the following steps:

[0018] transmitting a radio signal from a central unit instructing all radio communication units within a certain range to identify themselves

[0019] transmitting response signals from each portable radio communication unit within the range;

[0020] transmitting instructions from the central unit to each portable radio communication units in dependence of the content of the response signal;

[0021] the portable radio communication unit responding to the instructions.

[0022] In this way, portable radio communications device may be switched off automatically by the first radio communication device, or the user of the mobile phone can be reminded that the phone should be turned off.

[0023] According to a preferred embodiment the first radio communication device is adapted to transmit an alarm if all mobile terminals do not respond to said message or order within a certain time period.

[0024] According to another embodiment the portable radio communication device is adapted to shut itself down when instructions to do so are received.

[0025] Instructions may also, instead of a shutdown command, comprise the order to notify the person carrying the portable radio.

[0026] It is foreseen that in a few years' time, most mobile telephones will include low power radio transmitters having a range of, typically, 10 m or 100 m, for example according to the Bluetooth standard. These radio transmitters will be used for a number of purposes:

[0027] For signalling to and from a telephone in the PSTN network so that the mobile telephone can be used as a cordless phone in the PSTN network when the user is close enough to his/her home telephone, or to connect a wireless headset to either the mobile phone or to the PSTN network using Bluetooth.

[0028] To transmit data between the mobile telephone and other units, for example personal computer, for example, if the user keeps a diary and/or a phone book in the mobile phone and wants the diary and/or phone book in his/her PC to be updated with information from the mobile telephone.

[0029] These functions are described, for example, in WO97/34403 and WO 98/11707.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] In the following, the invention will be described in more detail, by way of preferred embodiments and with reference to the drawings, in which:

[0031] **FIG. 1** is an overall schematic representation of the units according to the invention and how they interact;

[0032] **FIG. 2** is a schematic representation of a mobile telephone according to one embodiment of the invention;

[0033] **FIGS. 3A and 3B** are flow charts of a first and a second embodiment of the method according to the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0034] **FIG. 1** is a schematic representation of the units according to the invention. In this example the method according to the invention is implemented for a building **1**, but it may just as well be an airplane, or the gate area at an airport, or any other area.

[0035] In the building **1**, there are a number of mobile telephones **3, 5** that may be used for mobile communication in mobile telephone networks, represented in the Figure by a base station **7**. This type of communication is well known in the art. The mobile telephones **3** may operate according to any standard known in the art, including Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Code Division Multiple Access (CDMA), and Wideband CDMA. Accordingly the mobile terminals will not all connect to the same base station. Each mobile terminal will connect to a base station **7** in a network providing the appropriate standard. However, for simplicity, only one base station is shown in this figure, since the communication between the mobile telephones and the telephone networks is not essential to the invention.

[0036] In the example, one mobile telephone **3** in the building **1** is currently involved in a connection to the base station **7**. Another mobile phone **5** is not involved in a connection, but is turned on. There may be other telephones in the building that are not turned on. These phones will not be affected by the invention, and are not shown. There are, of course, also a number of mobile telephones **9** outside the building.

[0037] In the building **1** there is also a central radio unit **11** comprising a transmitter **13** transmitting low power radio signals. The power of the radio signals is adjusted so that the signal will be received by mobile telephones **3, 5** inside the building, but not the mobile telephones **9** outside the building.

[0038] The low power radio signal tells the mobile telephones **3, 5** to respond by transmitting a similar signal to identify themselves to the central unit **11**, for example, by the type of equipment they are. This signal is received by a receiving part **15** and processed in a processor **17** in the central unit **11**. This identification is necessary, or at least desirable, to make sure that only equipment that really has to be turned off is, especially in the cases when an alert is sent out if all radio transmitting equipment is not turned off. For example, there is no need to turn off television sets or radios. The processor **17** also controls the transmitting and receiving parts **13, 15**.

[0039] In order for the method according to the invention to work, the mobile telephone must include a low power radio transmitter of the specified kind, and software for handling the functions, as will be described in connection with **FIGS. 2 and 3**. For mobile phones not including such units, a piece of additional equipment may be used to enable the mobile phone to communicate with the central radio unit.

[0040] **FIG. 2** shows a general mobile telephone **21** according to the invention. As an example, a GSM telephone is shown.

[0041] The telephone shown in **FIG. 2** comprises an antenna **27** used to receive and transmit signals through the air interface. The signals received by the antenna are processed in a radio unit **29** and a processing unit **31** before they are played to the subscriber through a loudspeaker **33**. The actual processing steps performed, such as demodulation, D/A conversion equalization and decoding, depend on the signalling system and are well known to the person skilled in the art. Speech is registered by a microphone **35** and processed by the processing unit **31** and the radio unit **29** before it is transmitted from the antenna **27**. As common in the art, the processor may also control a keyset and display (not shown).

[0042] According to the invention, the telephone also comprises a short-range radio transmitter unit **37**, for example, a Bluetooth transmitter, controlled by the processing unit **31**.

[0043] As discussed above, the short-range radio transmitter included in the mobile terminal according to the invention may, and probably will, be used for other purposes than that according to the invention.

[0044] If the hardware and/or software needed for the method according to the invention is not included in the mobile terminal, a plug-in unit comprising the necessary hardware and software can instead be connected to the mobile telephone.

[0045] **FIG. 3A** is a flow chart of the method according to a first embodiment of the invention:

[0046] Step **101**: The central unit sends out a request signal requesting all mobile telephones and other units transmitting radio signals to identify themselves.

[0047] Step **102**: Each radio transmitting unit, when receiving the signal from the central unit, identifies itself to the central unit by a response signal. This signal preferably includes the type of unit and the type or types of communication it may engage in.

[0048] Step **103**: The central unit interprets each of the response signals received, and determines for each communication device that has responded, if this device has to be turned off or not, or to be partially turned off.

[0049] Step **104**: If the device should be turned off, go to step **105**; if an instruction or another message should be sent to the device , go to step **107**; if nothing should happen, end of procedure.

[0050] Step **105**: The central unit orders the device to turn itself off.

[0051] Step 106: The device turns itself off. The next time a request signal is sent out from the central unit, this device will not be registered. End of procedure.

[0052] Step 107: The central unit sends a message to the communication device. Any type of message that the device can handle may be sent, for example "turn of mobile phones", or "switch to short distance radio for communication". End of procedure.

[0053] FIG. 3B is a flow chart of the method according to a second embodiment of the invention:

[0054] Step 201: The central unit sends out a request signal requesting all mobile telephones or other units transmitting radio signals to identify themselves.

[0055] Step 202: Each unit transmitting radio signals, when receiving the signal from the central unit, identifies itself to the central unit by a response signal.

[0056] Step 203: The central unit interprets each of the response signals received, and determines for each communication device that has responded, if this device has to be turned off or not.

[0057] Step 204: If the device should be turned off, go to step 205; if nothing should happen, end of procedure.

[0058] Step 205: The central unit orders the device to turn itself off. If the device offers several communication functions, for example, communication in a cellular network, which may be dangerous, and low power radio communication, only the undesired functions will have to be turned off, for example, the long-distance radio transmitting parts.

[0059] Step 206: The device transmits a confirmation signal to the central unit, then turns itself off.

[0060] Step 207: If confirmation signals are not received from all devices that should be turned off, within a certain amount of time, a message may be transmitted. This may be a private alert to the owner of the device that was not turned off, or a public alert or alarm. For example, in airplanes or in hospitals, a public alert may be appropriate to draw attention to the fact that electronic equipment may be disturbed. End of procedure.

1. A first radio communication device (11) comprising

transmitting means (13, 17) for transmitting a radio signal instructing portable radio communication devices within a certain range from the unit to identify themselves; receiving means (15, 17) for receiving and interpreting the response signals; and, means (13, 17) for, in dependence of the response signal received from each radio communication device:

transmitting a message to the radio communication device

transmitting a message to the user of the radio communication device, or

ordering the radio communication device to turn itself off

2. A first radio communication device according to claim 1, adapted to transmit an alarm if all mobile terminals do not respond to said message or order within a certain time period.

3. A first radio communication device according to claim 1 or 2, adapted to order a mobile terminal that does not respond to said message or order within a certain time period to turn off the cellular communication function.

4. A first radio communication device according to claim 1, 2 or 3, adapted to order mobile terminal that does not respond to said message or order within a certain time period to switch to a short range communication mode.

5. A first radio communication device according to claim 1, 2, 3 or 4, wherein the transmitting means (13) and/or the receiving means (15) are short range wireless communication means, for example according to the Bluetooth standard.

6. A portable radio communication device (21) comprising means for communicating in a cellular telephone network and low power radio communication means characterized in that it comprises identifying means (37) for

in response to a low power radio message instructing it to identify itself, transmitting a response signal;

receiving a message and/or instructions and act upon them.

7. A portable radio communication device according to claim 6, adapted to shut itself down when instructions to do so are received.

8. A portable radio communication device according to claim 6 or 7, adapted to switch to a short-range communication mode when instructions to do so are received.

9. A portable radio communication device according to claim 6, 7 or 8, wherein said identifying means (37) is a short-range wireless communication means, for example according to the Bluetooth standard, for receiving said low power radio message.

10. A method of controlling the use of mobile terminals, comprising the following steps:

transmitting a radio signal from a central unit instructing all radio communication units within a certain range to identify themselves

transmitting response signals from each portable radio communication unit within the range;

transmitting instructions from the central unit to each portable radio communication units in dependence of the content of the response signal;

the portable radio communication unit responding to the instructions.

11. A method according to claim 10, wherein said instructions comprise the order to notify the person carrying the portable radio.

12. A method according to claim 10 or 11, wherein said instructions comprise the order to the portable radio communication unit to turn itself off.

13. A method according to any one of the claims 10-12, wherein said instructions comprise the order to the portable radio communication unit to turn off the cellular communication function.

* * * * *

US006463272B1

(12) **United States Patent**
Wallace et al.

(10) **Patent No.: US 6,463,272 B1**
(45) **Date of Patent: Oct. 8, 2002**

(54) **LOCATION REPORTING PAGER**

(75) Inventors: **David W. Wallace**, Mesa, AZ (US); **Christopher M. Moropoulos**, San Carlos, CA (US)

(73) Assignee: **Intel Corporation**, Santa Clara, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/217,916**

(22) Filed: **Dec. 21, 1998**

(51) **Int. Cl.**[7] **H04M 11/00**; H04Q 7/20
(52) **U.S. Cl.** **455/404**; 455/456
(58) **Field of Search** 455/404, 456, 455/457, 403; 340/539, 426; 342/357.09, 357.07; 701/213

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,577,060	A *	3/1986	Webb et al.	455/31.2
4,871,997	A *	10/1989	Adriaenssens et al.	340/539
5,365,451	A	11/1994	Wang et al.	
5,418,537	A *	5/1995	Bird	342/357.09
5,490,200	A	2/1996	Snyder et al.	
5,491,486	A	2/1996	Wells, II et al.	
5,504,491	A *	4/1996	Chapman	342/357.09
5,588,038	A *	12/1996	Snyder	455/31.3
5,594,425	A	1/1997	Ladner et al.	
5,608,412	A	3/1997	Welles, II et al.	
5,625,668	A	4/1997	Loomis et al.	
5,630,206	A	5/1997	Urban et al.	
5,682,139	A	10/1997	Pradeep et al.	
5,686,888	A	11/1997	Welles, II et al.	
5,686,910	A	11/1997	Timm et al.	
5,691,980	A	11/1997	Welles, II et al.	
5,703,598	A *	12/1997	Emmons	342/357.07
5,742,233	A	4/1998	Hoffman et al.	
5,748,147	A	5/1998	Bickley et al.	
5,777,580	A	7/1998	Janky et al.	
5,917,405	A *	6/1999	Joao	340/426
5,983,074	A *	11/1999	Jansen	455/31.3
6,044,257	A *	3/2000	Boling et al.	455/404
6,084,510	A *	7/2000	Lemelson et al.	340/539
6,112,074	A *	8/2000	Pinder	455/404
6,115,605	A *	9/2000	Siccardo	455/426
6,122,520	A *	9/2000	Want et al.	455/456
6,122,521	A *	9/2000	Wilkinson et al.	455/457
6,131,067	A *	10/2000	Girerd et al.	701/213

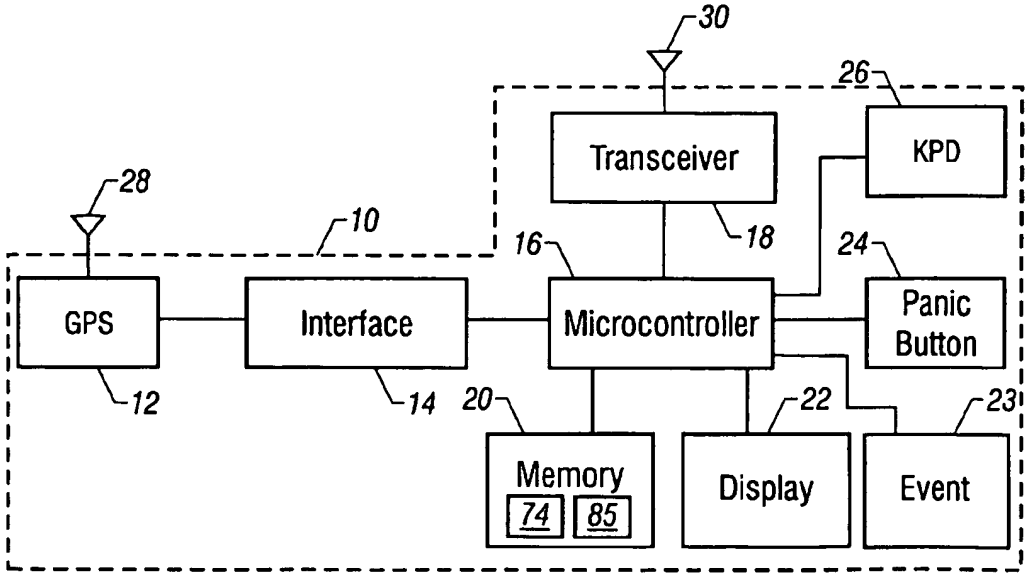
* cited by examiner

Primary Examiner—Nguyen T. Vo
(74) *Attorney, Agent, or Firm*—Trop, Pruner & Hu, P.C.

(57) **ABSTRACT**

A pager includes a global positioning system receiver so that the pager may be interrogated by a remote requester for the user's current location. The information can be provided to the requester in response to a request made over the Internet. The requester can be queried for authentication information before providing the information. In this way, the positioning information may be obtained automatically without requiring any action on the part of the pager owner.

7 Claims, 4 Drawing Sheets



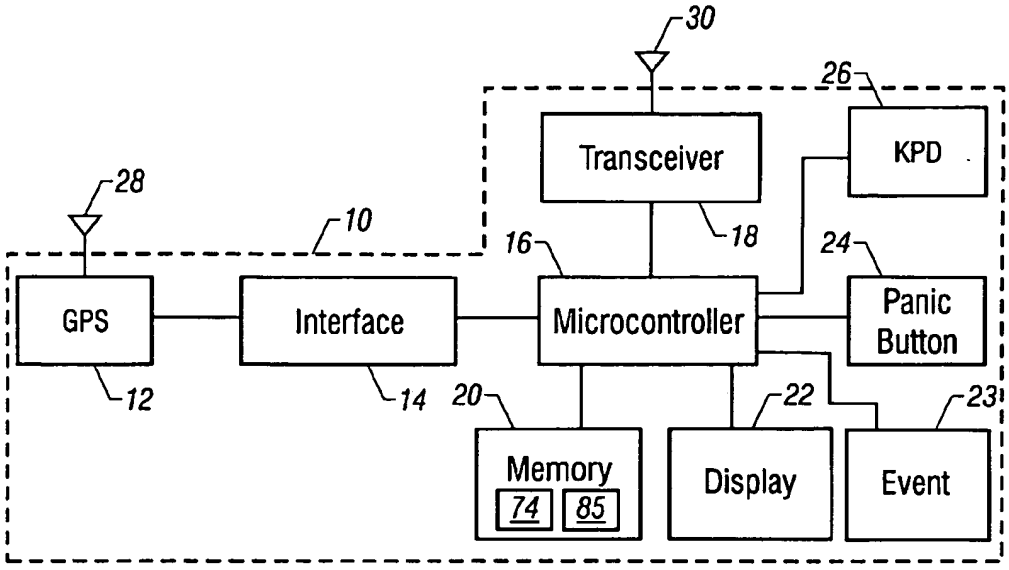

30
26
Transceiver
KPD
28
10
16
18
24
GPS
Interface
Microcontroller
Panic Button
12
14
20
22
23
Memory
74
85
Display
Event

FIG. 1

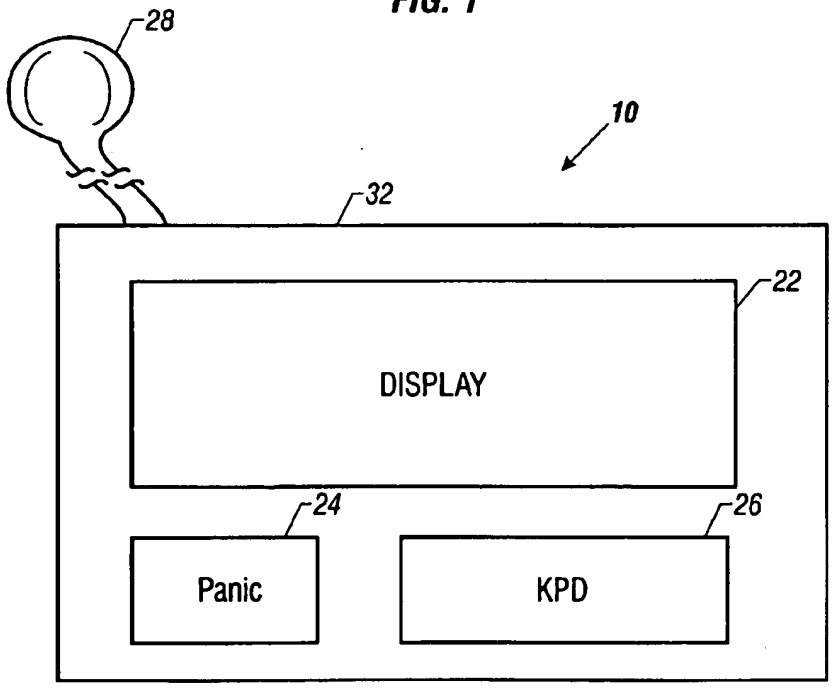

28
10
32
22
DISPLAY
24
26
Panic
KPD

FIG. 2

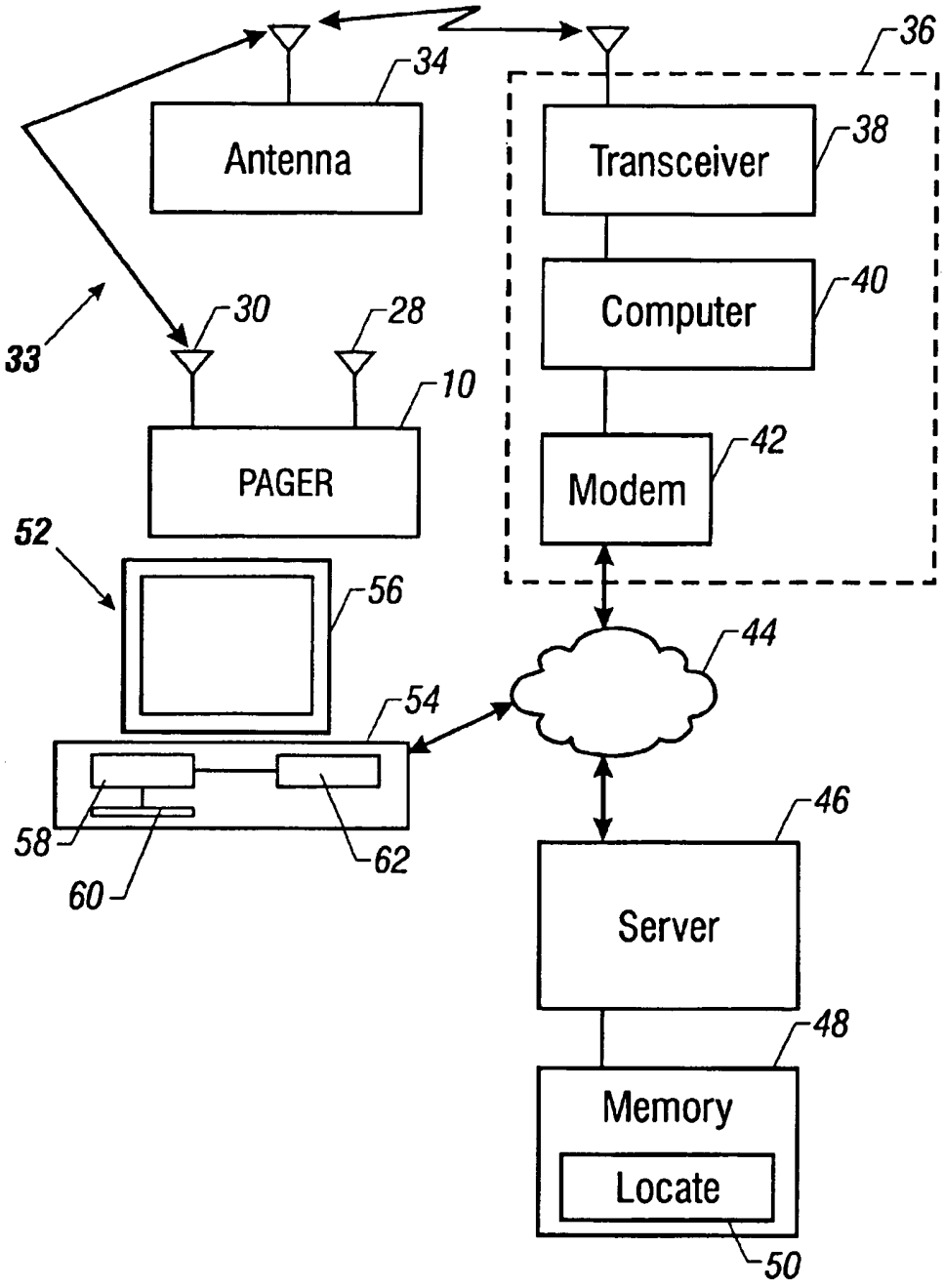

36
34
Antenna
Transceiver
38
Computer
40
33
30
28
10
PAGER
Modem
42
52
56
44
54
58
60
62
46
Server
48
Memory
Locate
50

FIG. 3

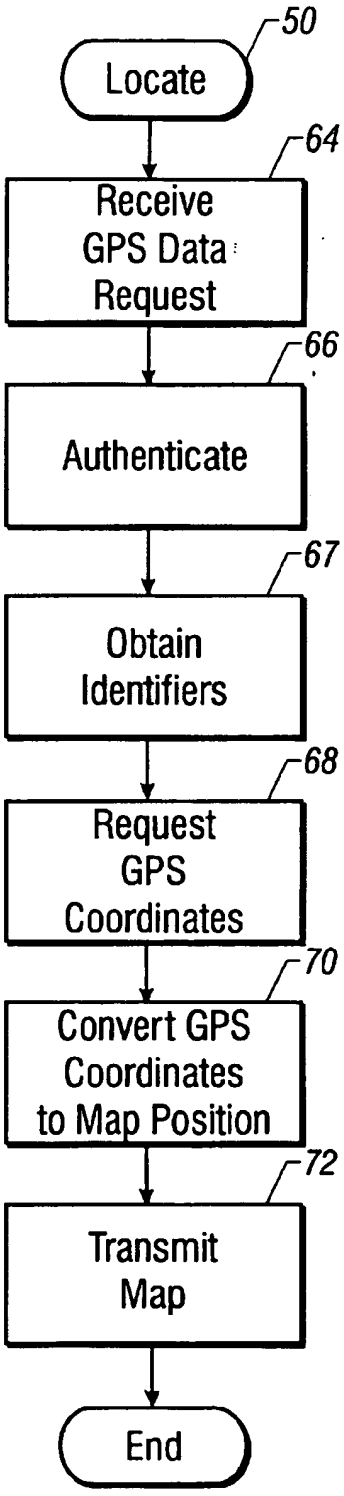

50
Locate
64
Receive GPS Data Request
66
Authenticate
67
Obtain Identifiers
68
Request GPS Coordinates
70
Convert GPS Coordinates to Map Position
72
Transmit Map
End

FIG. 4

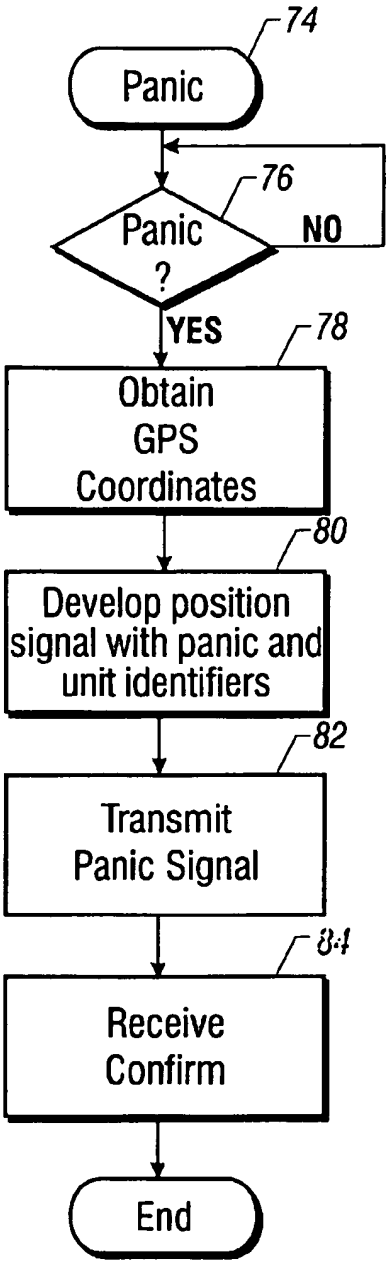

74
Panic
76
Panic ?
NO
YES
78
Obtain GPS Coordinates
80
Develop position signal with panic and unit identifiers
82
Transmit Panic Signal
84
Receive Confirm
End

FIG. 5

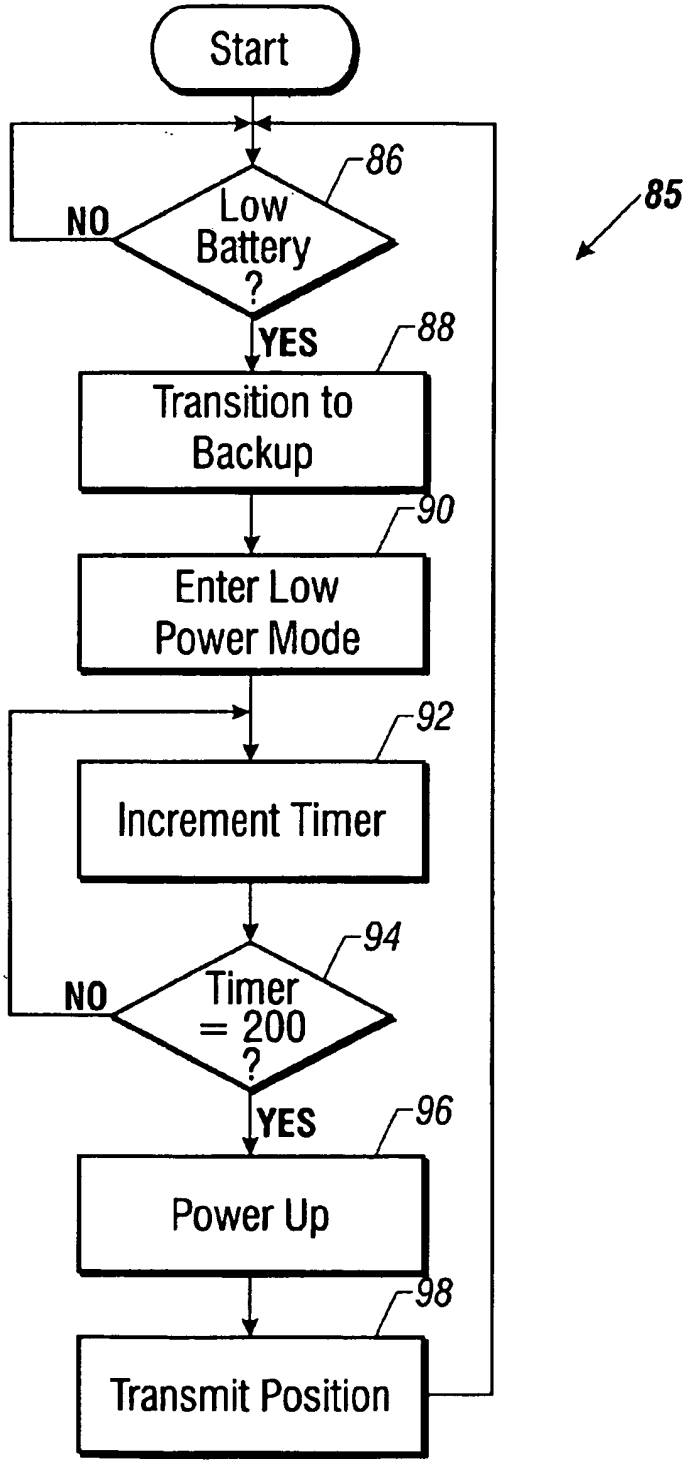

Start
86
Low Battery ?
NO
YES
88
Transition to Backup
90
Enter Low Power Mode
92
Increment Timer
94
Timer = 200 ?
NO
YES
96
Power Up
98
Transmit Position
85

FIG. 6

LOCATION REPORTING PAGER

BACKGROUND

The invention relates generally to pagers.

Pagers are generally worn by a user and allow either one-way or two-way communications. With one-way communication, the user may receive an audible or vibratory indication that someone is trying to reach him or her. Some pagers also allow for messaging so that the user may receive an actual phone number or even a text message. Two-way pagers allow the pager user to send communications to other parties.

Some pagers enable contact through the Internet. A person may access a web site and send a message addressed to a pager by typing a message into the web site and identifying the pager. The message is automatically transmitted to the identified pager.

There are a number of instances where it is very desirable to locate a particular person. It may be advantageous in keeping track of a number of workers to be able to know at any particular time where those workers are. In some cases, it may be desirable for parents to keep track of where their children are. In other cases, it may be a benefit in situations where a person could become lost.

In many of these cases it may be desirable that the user be located without actually telling the user that the user is being located. For example, if the user has disappeared, has been kidnapped, or has been injured, it may be desirable to locate the user even though the user does not or cannot respond to a page. In other cases the user may prefer not to be bothered with location requests.

SUMMARY

In accordance with one embodiment, a pager includes a global positioning system receiver and a transceiver. The transceiver is coupled to the receiver to transmit global positioning system coordinates of the receiver.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram depiction of a pager in accordance with one embodiment of the present invention;

FIG. **2** is a top plan view of the housing for the pager shown in FIG. **1**;

FIG. **3** is a block diagram depiction of a pager system that could be used in connection with the pager shown in FIG. **1**;

FIG. **4** is a flow chart for software which may be utilized by the system shown in FIG. **3**;

FIG. **5** is a flow chart showing software for implementing a panic feature in the pager of FIGS. **1** and **2**; and

FIG. **6** is a flow chart showing software for implementing a power down mode.

DETAILED DESCRIPTION

Referring to FIG. **1**, a two-way pager **10** may include a global positioning system (GPS) antenna **28**. The GPS antenna **28** provides a GPS positioning signal to a (GPS) receiver **12**. The receiver **12** communicates with a controller **16** through an interface **14**. The interface **14** could, for example, be an RS-232 or IEEE 488 adapter. The controller **16**, which may be a microcontroller, may be responsible for receiving the global positioning coordinates developed by the receiver **12** and providing them to the transceiver **18** for broadcast from the antenna **30**.

The controller **16** includes a memory **20** which may include software **74** for implementing the features associated with the pager **10**. The controller **16** may also control a display **22** which could, for example, be a liquid crystal display. As an example, the display **22** is controllable by the controller **16** to display a map showing the pager's position. In addition, the controller **16** may in fact interact with a keypad **26** which allows alphanumeric characters to be entered for transmission by the transceiver **18** or for other functions.

The microcontroller **16** may also communicate with an event generator **23**. The event generator **23** may be responsible for receiving one or more inputs for keeping track of one or more events. The event generator **23** may also generate a signal to the controller **16** which may be in the form of an interrupt when a particular preprogrammed event is detected. Among the events that may be detected is acceleration of the pager **10**, exceeding a low or high temperature set point, humidity, moisture, exceeding a time period for taking a particular action or for having an event occur, receiving a transmission, or other similar events.

In response to the receipt of an event from the event generator **23**, the microcontroller **16** may take appropriate action. In one embodiment of the invention, the microcontroller **16** causes a message to be generated which defines the event and specifies the location where the pager was when the event occurred. This event information may be immediately transmitted to a base station or it may be stored and transmitted at a later time. For example, the pager **10** may transmit events periodically at predetermined times.

In addition, the event generator **23** may keep track of the GPS coordinates of the pager **10**. If those coordinates deviate from the coordinates of a preprogrammed course or area, an event may be generated. For example, the user may input a predetermined path of travel. If the user substantially departs from that path of travel, an event may be generated causing a transmission to occur. For example, if the user is kidnapped, a signal may be automatically generated once the user departs from the preprogrammed path. Similarly, if the pager **10** is associated with an article, such as a container in the course of shipping, if the container takes a course which is not within the preprogrammed specifications, an event may be generated.

The generated events may result in immediate transmission or, as described above, these transmissions may occur at periodic intervals. As still another alternative, the microcontroller **16** may store the information about the events and may transmit the information when a request is received by the GPS receiver **12**, for example from a base station.

The controller **16** also controls a panic feature which may be implemented by operating a panic operator such as a panic button **24**. When a panic button is operated, the controller, in accordance with software that may be stored in the memory **20**, automatically transmits the global positioning system coordinates of the pager **10**. This transmission may also include an identifier for the particular pager **10** and an indicator of the condition that has been encountered or, in general, that an emergency has arisen.

Referring to FIG. **2**, one exemplary housing **32** for implementing the embodiment shown in FIG. **1** includes a display **22**. The keypad **26** and a panic button **24** may be provided adjacent to the display **22**. A global positioning system antenna **28** may be connected to the housing **32**.

The pager **10** may be battery powered and may include a backup battery in case the main battery fails. A low battery report may be transmitted to alert others that imminent battery failure may occur. This low battery information may also be used to transition the pager to a sleep mode. The

pager may be automatically awoken at a preset time or after the expiration of a given time period. Once transitioned out of the sleep mode, the pager may automatically transmit new position information.

In the sleep mode the microcontroller, the display and other components may transition to a reduced power consumption mode. However, the receiver is always ready to receive a message. The power down cycle may be triggered by a lack of activity for a given time. Also, the power down device may be automatically, periodically powered up.

Referring to FIG. **6**, software **85** may be stored in the memory **20** to implement a power saving mode. If a lower battery condition is detected (diamond **86**), the system may activate a backup battery (block **88**). The pager may then automatically transition to a low power mode, as indicated in block **90**. In this state transmission and receipt of messages and operation of the display may be suspended.

A timer may be incremented (block **92**) until a given time period has passed (diamond **94**). The pager may then be automatically powered up (block **96**) to transmit a position message (block **98**). Thereafter the pager may be automatically transitioned back to the low power mode (block **90**).

Moving now to FIG. **3**, a paging system **33** which uses the pager **10** may also include one or more antennas **34** which are associated with a conventional paging system. The antennas **34** transmit page messages to pagers **10** in the vicinity of the antenna **34**. In most page systems, a large number of antennas **34** are distributed throughout any given area and across the country. The pager **10** may be a two-way pager which communicates with the antenna by sending and receiving messages from the antenna **34** which happens to be proximate to the pager **10** at any particular time.

The antenna **34** then repeats the messages it receives from pagers and forwards them to a paging central station **36**. The central station **36** may include a transceiver **38**, a computer **40** and a modem **42**.

The modem **42**, under the control of computer **40**, may access information over the Internet **44**. For example, a server **46** coupled to the Internet **44** may be associated with memory **48** and software **50**. The server **46** may also be contacted by a remote computer **52** using a computer having a display screen **56** and a computer housing **54**. The computer housing **54** may contain a processor **58**, a modem **62** and a memory **60** connected in a conventional fashion. The user of the computer **52** may query an Internet web site to send page messages to any particular pager **10**. One may also request position information for a particular pager. When a request for position information is sent over the Internet **44** from a computer **52**, it is processed by the server **46** using resident memory **48** and software **50**. The server **46** may access the modem **42** and send a message from the station **36** to the antenna **34** to locate the pager **10**.

A variety of pager location systems may be utilized. In some systems, the pager may need to periodically transmit its position so that the system can locate it. In other systems, a message may be sent throughout the area in which the pager might be found so that wherever the pager is, it receives a message.

Thus the server **46** determines the pager's position by prompting the pager to send a message containing its global position system coordinates. These coordinates may then be provided to the computer **52** if appropriate authentication is provided.

To facilitate the use of the information by the computer **52**, the server **46** may provide the global positioning system information in the form of a map showing the current position of the pager **10**. Alternatively, the server **46** can provide appropriate information and the position may then be displayed on a map using software contained in the memory **60** of the computer system **52**.

Since the pager **10** is always "on", the system **33** can always locate the pager whether or not the pager owner actually knows that he or she is being located. In some cases, the pager owner **10** may limit the persons who have access to the location information. This function may be policed by the server **46** which includes a database of authorized users contained in the memory **48**. Only if one of these users, presenting appropriate authentication, inquires of the location of the pager **10**, is the mapping information provided by the server **46**.

Referring now to FIG. **4**, the software **50** executable in the server **46** for operating the system **33** initially receives a request for GPS data (block **64**). This request is authenticated as indicated in block **66** to ensure that the inquiring party is authorized to receive information about the particular pager. Once authenticated, a party may communicate with the pager **10**. If the party is authorized to receive the information, the appropriate identifiers for the particular pager which is the subject of the request are obtained (block **67**) and the GPS coordinates are requested from the central station **36**, as indicated in block **68**. The central station **36** then uses conventional technology to locate the appropriate antenna **34** to communicate with the pager **10**.

When the GPS coordinates are received, the coordinates are converted into a map position using the software contained in the memory **48**, for example, as indicated in block **70**. The map information is then transmitted back to the requesting party over the Internet as indicated in block **72**.

Turning now to FIG. **5**, the software **74** for implementing the panic function in the pager **10** initially determines whether the panic button **24** has been operated, as shown in diamond **76**. When the button is operated, the GPS coordinates are immediately obtained from the GPS receiver **12**, as indicated in block **78**. A signal is produced by the transceiver **38** which may include an indicator that a panic condition has been encountered and identifiers for the particular pager involved. The panic signal is transmitted by the transceiver **18** as indicated in block **82**. When the panic signal is received by the station **36**, a panic condition is recognized and a confirmation may be sent back to the pager **10** through the antenna **34** to assure the pager owner that the message is being handled.

Through the provision of global positioning system information on a pager, the pager owner can always be contacted and his/her position determined without requiring any active involvement of the pager owner. This has a number of advantages in connection with locating persons who may not be able to respond. It may also be useful in locating objects or pets. In addition to the provision of the panic feature, the pager owner can initiate a transmission of his/her position so that the appropriate authority will be notified and provide assistance to the user. Because the user's position can be determined through an Internet access with appropriate authentication safeguards, it is possible for interested parties to easily and quickly determine a person's location without needing to bother the person with an inquiry.

In addition, the pager may include the ability to display a simple map depicting the user's present location. This position information may be displayed on the display **22**. The user may be able to invoke the position map display by entering a command on the keypad **26**. The data to create the map may be preloaded into the pager or it may be trans-

mitted to the pager as a pager message. Alternatively, the proper map region, for the user's present position, may be sent in response to a position message.

The pager **10** may also be programmed to automatically report (by a page message) when it enters or leaves a particular zone. This message may be Internet accessible. This may be useful in keeping track of persons or objects. The pager **10** may also be programmed to automatically contact certain people when the pager enters a particular zone.

The pager **10** may also monitor other information such as temperature, altitude, moisture or acceleration and may transmit this information automatically or upon request. In addition, the pager **10** may interpolate its position using a digital accelerometer for example, when the pager is unable to obtain a good GPS position.

Other features may include a watch dog timer which automatically sends an alarm message if the user fails to periodically reset a timer. In addition, an alarm may be triggered if the pager is removed from the user without disabling the alarm, for example by entering a key sequence. For this purpose the pager housing may include a hinged clasp with a sensor to detect removal of the pager from the user's clothing.

The pager may be linked to a service desk which may provide position information on demand. The service desk may also attempt to contact the user when an emergency is indicated.

While the present invention has been described with respect to a limited number of embodiments, those skilled in the art will appreciate numerous modifications and variations therefrom. It is intended that the present invention encompass all such variations and modifications as fall within the true spirit and scope of the present invention.

What is claimed is:

1. A pager comprising:

a global positioning system receiver; a transceiver coupled to said receiver to transmit global positioning coordinates of the receiver, said transceiver being operable to automatically transmit said coordinates when a request for the coordinates is received;

an event generator coupled to said transceiver, said event generator to track the global positioning coordinates of said receiver such that when said tracked global positioning coordinates deviate from a set of preprogrammed coordinates said deviated coordinates are automatically transmitted by said transceiver;

a power down device that transitions said pager into a sleep mode when a battery is low, said pager periodically awakening from said sleep mode to automatically transmit said global positioning coordinates of said receiver; and

a user selectable panic operator, such that once the operator is operated, said transceiver automatically sends a message indicating that help is needed and including the coordinates of the global positioning system receiver.

2. The pager of claim **1** including a display controller.

3. The pager of claim **2** including a memory, said display controller adapted to display a map showing the receiver's location.

4. The pager of claim **1** wherein said message includes the global positioning system coordinates for the receiver.

5. The pager of claim **4** wherein said message includes an identifier for said pager.

6. The pager of claim **4** including a controller adapted to automatically obtain the global positioning system coordinates once said panic operator is operated and to transmit said message automatically.

7. A pager comprising:

a transmitter to transmit signals to a receiving station;

a panic operator operable to select a panic function, said panic function causing said transmitter to transmit a coded signal which may be recognized as a request for help together with the coordinates of the transmitter;

a global positioning system receiver connected to said transmitter, said transmitter adapted to transmit the global positioning system coordinates of the pager at the time when the panic operator is operated;

an event generator coupled to said global positioning system receiver, said event generator to track the global positioning system coordinates of said receiver such that when said tracked global positioning coordinates deviate from a set of preprogrammed coordinates said deviated coordinates are automatically transmitted by said transceiver; and

a power down device to transition said pager into a sleep mode when a battery is low, said pager periodically awakening to automatically transmit the global positioning system coordinates of said receiver.

* * * * *

US006608559B1

(12) **United States Patent**
Lemelson et al.

(10) **Patent No.: US 6,608,559 B1**
(45) **Date of Patent: *Aug. 19, 2003**

(54) **DANGER WARNING AND EMERGENCY RESPONSE SYSTEM AND METHOD**

(76) Inventors: **Jerome H. Lemelson**, 930 Tahoe Blvd., Unit 802, Suite #286, Incline Village, NV (US) 89451-9436; **Robert D. Pedersen**, 7808 Glenneagle, Dallas, TX (US) 75248

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/603,300**

(22) Filed: **Jun. 23, 2000**

Related U.S. Application Data

(63) Continuation of application No. 08/844,029, filed on Apr. 18, 1997, now Pat. No. 6,084,510.

(51) **Int. Cl.**[7] **G08B 1/08**; H04N 7/18

(52) **U.S. Cl.** **340/539**; 340/905; 340/990; 340/517; 340/518; 340/601; 342/357.01; 342/451; 342/457; 348/135; 348/143; 348/144; 348/149; 382/103; 382/104; 701/200; 701/209; 701/210

(58) **Field of Search** 340/533, 531, 340/539, 601, 517, 518, 825.36, 825.49, 905, 990; 342/26, 27, 46, 352, 357.01, 362, 367, 385, 450, 451, 457; 348/135, 143, 144, 140, 149; 382/103, 104; 701/200, 207, 208, 209, 210

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,611,209	A	9/1986	Lemelson et al.	343/455
4,622,544	A	11/1986	Bially et al.	340/636
4,814,711	A	3/1989	Olsen et al.	342/357
4,856,047	A	8/1989	Saunders	379/57
4,887,291	A	12/1989	Stillwell	379/39
4,956,857	A	9/1990	Kurosaki	378/110
4,993,059	A	2/1991	Smith et al.	379/39
5,119,102	A	6/1992	Barnard	342/357
5,119,504	A	6/1992	Durboraw, III	455/54.1
5,182,566	A	1/1993	Ferguson et al.	342/357

(List continued on next page.)

OTHER PUBLICATIONS

Bezdek, Jim, "Editorial: Fuzzy Models—What Are They and Why?," *Applications of Fuzzy Logic Technology*, SPIE No. 2061, Boston, Mass., Sep. 8–10, 1993.

Brubaker, David, "Fuzzy Operators," *EDN*, pp. 239–241, Nov. 9, 1995.

Cox, Earl, "Fuzzy Fundamentals," *IEEE Spectrum*, pp. 76–81, Oct. 1992.

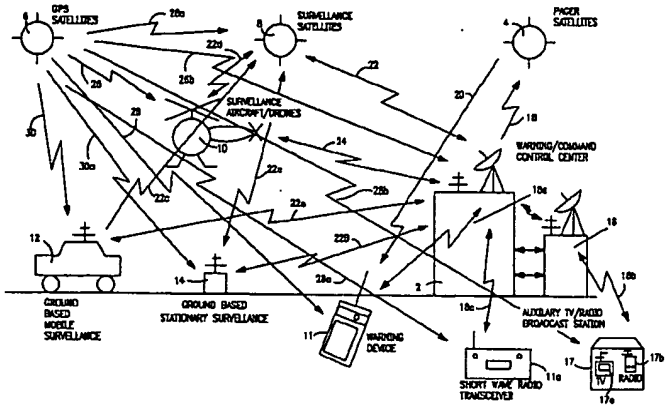
(List continued on next page.)

Primary Examiner—Donnie L. Crosland
(74) *Attorney, Agent, or Firm*—Steven G. Lisa; Douglas W. Rudy; Edwin A. Suominen

(57) **ABSTRACT**

Surveillance platforms detect dangers and transmit information signals describing the dangers to a control center, which determines the degree of danger and its geographic extent. The center generates a message that identifies the degree of danger and GPS coordinates of the impacted geographic area for a region. A vulnerability index determined using neural networks and fuzzy logic enables a prioritized message. The center broadcasts the message to remotely located warning devices, which compare the received danger coordinates with their own GPS coordinates and determine the extent to which they are in danger. Warning signals can issue automatically, appropriate to the degree of danger. Emergency manned vehicles may also directly receive the broadcast message and act appropriately relative to the degree of danger.

1 Claim, 18 Drawing Sheets



U.S. PATENT DOCUMENTS

5,187,805	A	2/1993	Bertiger et al.	455/12.1
5,202,829	A	4/1993	Geier	364/449
5,223,844	A	6/1993	Mansell et al.	342/357
5,225,842	A	7/1993	Brown et al.	342/357
5,243,652	A	9/1993	Teare et al.	380/21
5,247,440	A	9/1993	Capurka et al.	364/424.05
5,248,979	A	9/1993	Orme et al.	342/352
5,278,539	A	1/1994	Lauterbach et al.	340/539
5,311,197	A	5/1994	Sorden et al.	342/457
5,323,322	A	6/1994	Mueller et al.	364/449
5,334,974	A	8/1994	Simms et al.	340/990
5,345,244	A	9/1994	Gildea et al.	342/357
5,359,332	A	10/1994	Allison et al.	342/357
5,379,224	A	1/1995	Brown et al.	364/449
5,379,337	A	1/1995	Castillo et al.	379/45
5,382,958	A	1/1995	FitzGerald	342/386
5,389,934	A	2/1995	Kass	342/357
5,390,125	A	2/1995	Sennott et al.	364/449
5,396,540	A	3/1995	Gooch	379/59
5,408,238	A	4/1995	Smith	342/357
5,414,432	A	5/1995	Penny, Jr. et al.	342/357
5,415,167	A	5/1995	Wilk	128/653.1
5,418,537	A	5/1995	Bird	342/357
5,422,813	A	6/1995	Schuchman et al.	364/449
5,422,816	A	6/1995	Sprague et al.	364/449
5,430,656	A	7/1995	Dekel et al.	364/449
5,434,787	A	7/1995	Okamoto et al.	364/449
5,438,337	A	8/1995	Aguado	342/357
5,576,952	A	11/1996	Stutman et al.	364/413.02
5,636,245	A	6/1997	Ernest et al.	375/259
5,652,570	A	7/1997	Lepkofker	340/573
5,705,980	A	1/1998	Shapiro	340/539
5,712,619	A	1/1998	Simkin	340/539
5,731,757	A	3/1998	Layson, Jr.	340/573
5,731,785	A	3/1998	Lemelson et al.	342/457
5,742,233	A	4/1998	Hoffman et al.	340/573
6,084,510	A *	7/2000	Lemelson et al.	340/539

OTHER PUBLICATIONS

Gottwald, Siegfried, *Fuzzy Sets and Fuzzy Logic: The Foundation Application—from a Mathematical Point of View*, pp. 133–168, 1993.

Hurn, Jeff, *GPS—A Guide to the Next Utility*, Trimble Navigation, Ltd., pp. 7–12, 1989.

Hurn, Jeff, *Differential GPS Explained*, Trimble Navigation, Ltd., pp. 5–15, 1993.

Jang and Chuen–Tsai, "Neuro–Fuzzy Modeling and Control," *Proceedings of the IEEE*, vol. 83, No. 3, pp. 378–406, Mar. 1995.

Kosko and Isaka, "Fuzzy Logic," *Scientific American*, pp. 76–81, Jul. 1993.

Leick, Alfred, *GPS Satellite Surveying*, John Wiley & Sons, pp. 58–92, New York, 1990.

Logsdon, Tom, *The Navstar Global Positioning System*, Van Nostrand Reinhold, pp. 17–33, New York, 1992.

McNeil, Daniel, *Fuzzy Logic*, Simon & Schuster, pp. 101–126, New York, 1993.

Mendel, Jerry M., "Fuzzy Logic Systems for Engineering: A Tutorial," *Proceedings of the IEEE*, vol. 83, No. 3, pp. 345–377, Mar. 1995.

Schwartz, Klir, "Fuzzy Logic Flowers in Japan," *IEEE Spectrum*, pp. 32–35, Jul. 1992.

Brown, Stuart, "Timely Warning," *Popular Science*, p. 96 (Date Unknown).

* cited by examiner

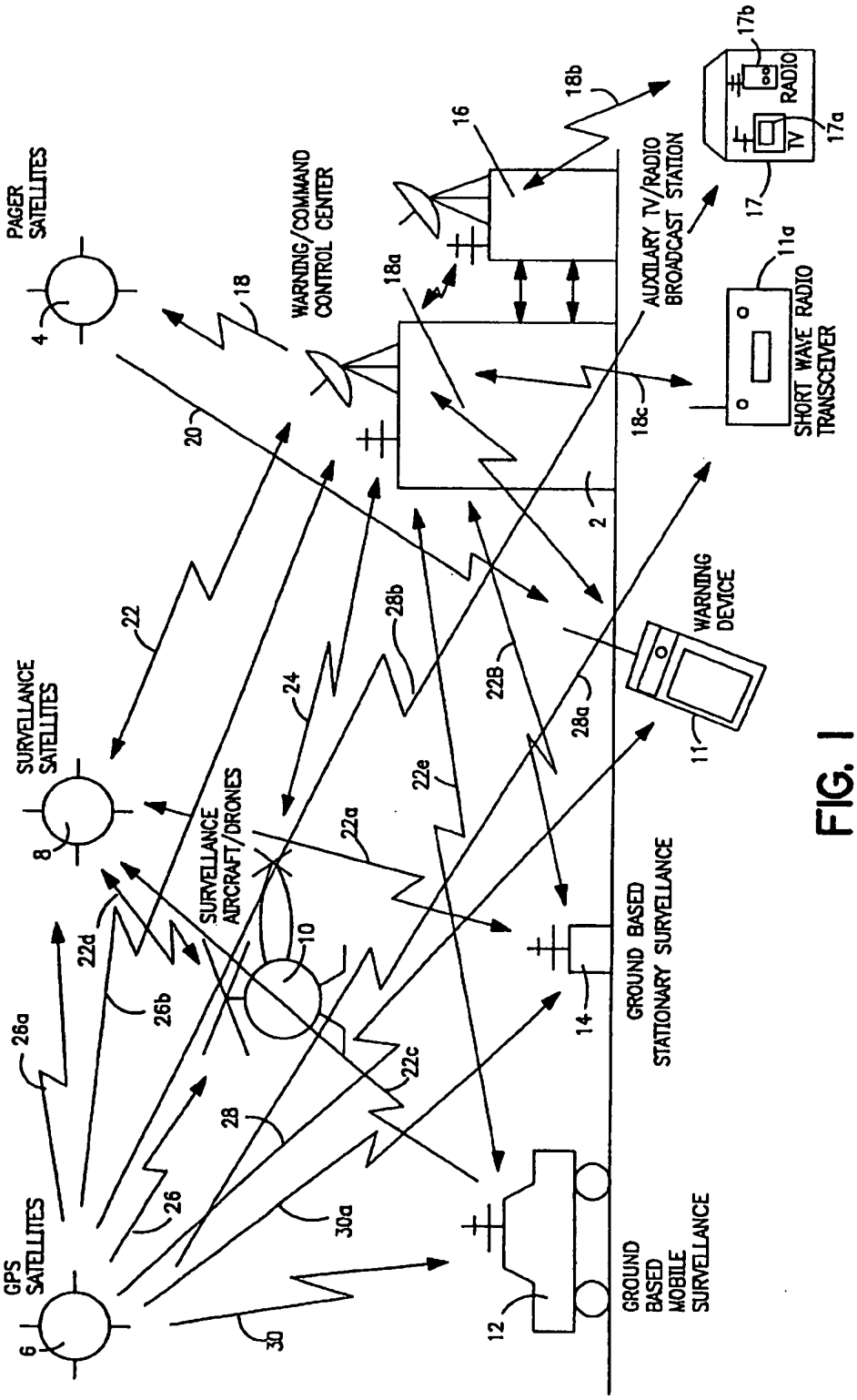

PAGER SATELLITES
4
18
WARNING/COMMAND CONTROL CENTER
18a
16
18b
AUXILARY TV/RADIO BROADCAST STATION
17b
RADIO
TV
17a
17
11a
SHORT WAVE RADIO TRANSCEIVER
18c
20
2
22
28b
24
22B
28a
WARNING DEVICE
11
SURVELLANCE SATELLITES
8
SURVELLANCE AIRCRAFT/DRONES
22a
22e
10
22d
26b
26a
22c
28
26
30a
GPS SATELLITES
6
30
14
GROUND BASED STATIONARY SURVELLANCE
12
GROUND BASED MOBILE SURVELLANCE

FIG. 1

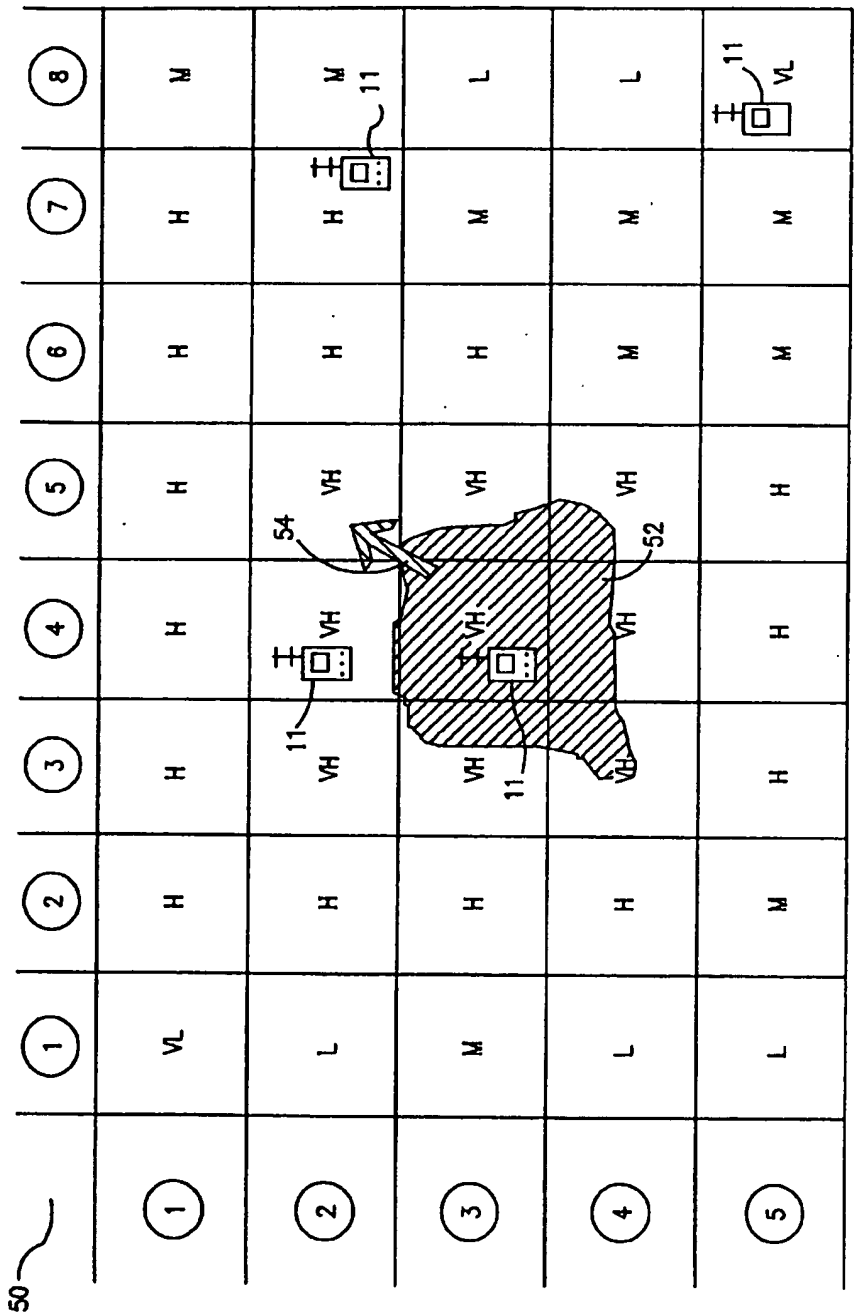

50
1
2
3
4
5
6
7
8
VL
L
M
H
VH
11
52
54
VL=VERY LOW
L =LOW
M =MODERATE
H =HIGH
VH =VERY HIGH

FIG. 2

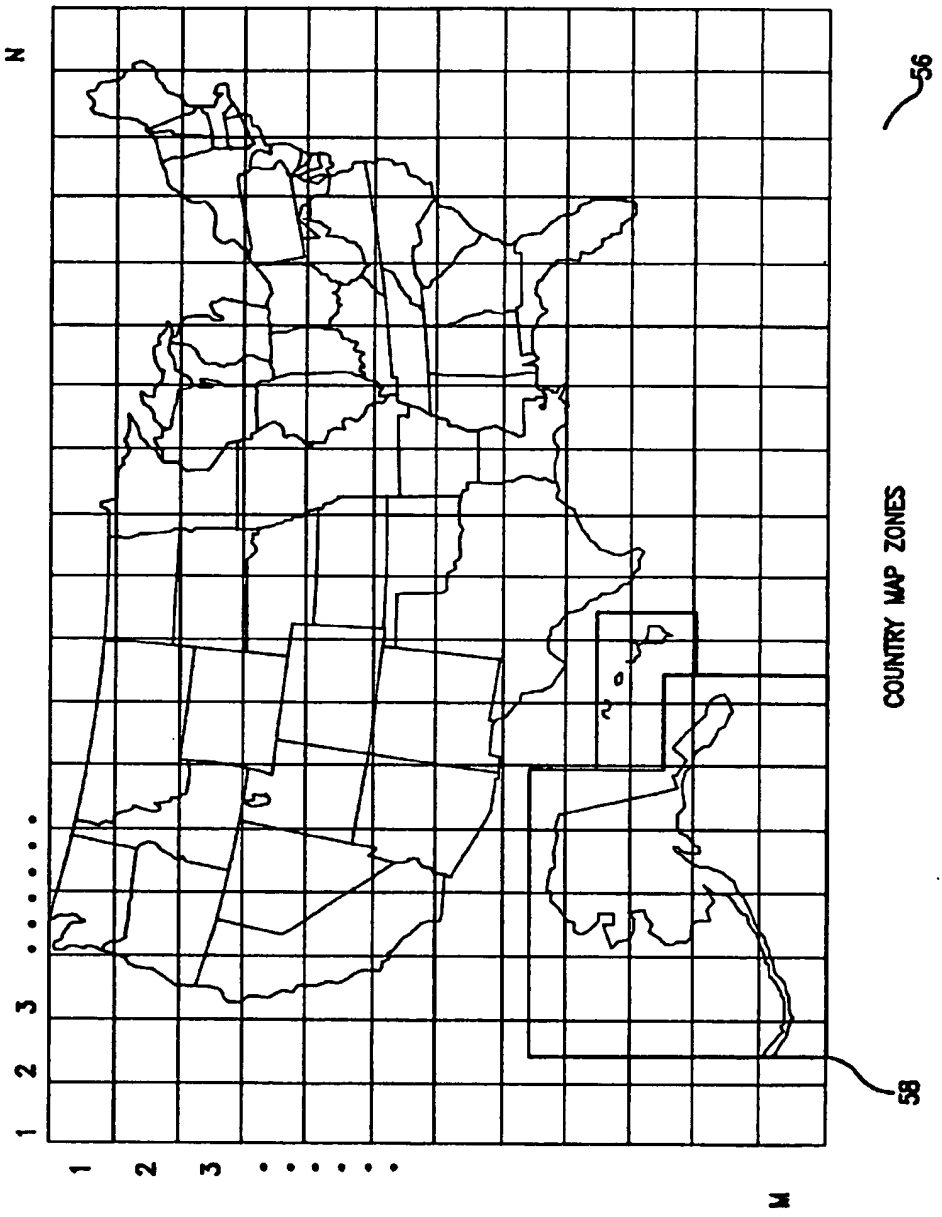


FIG. 3

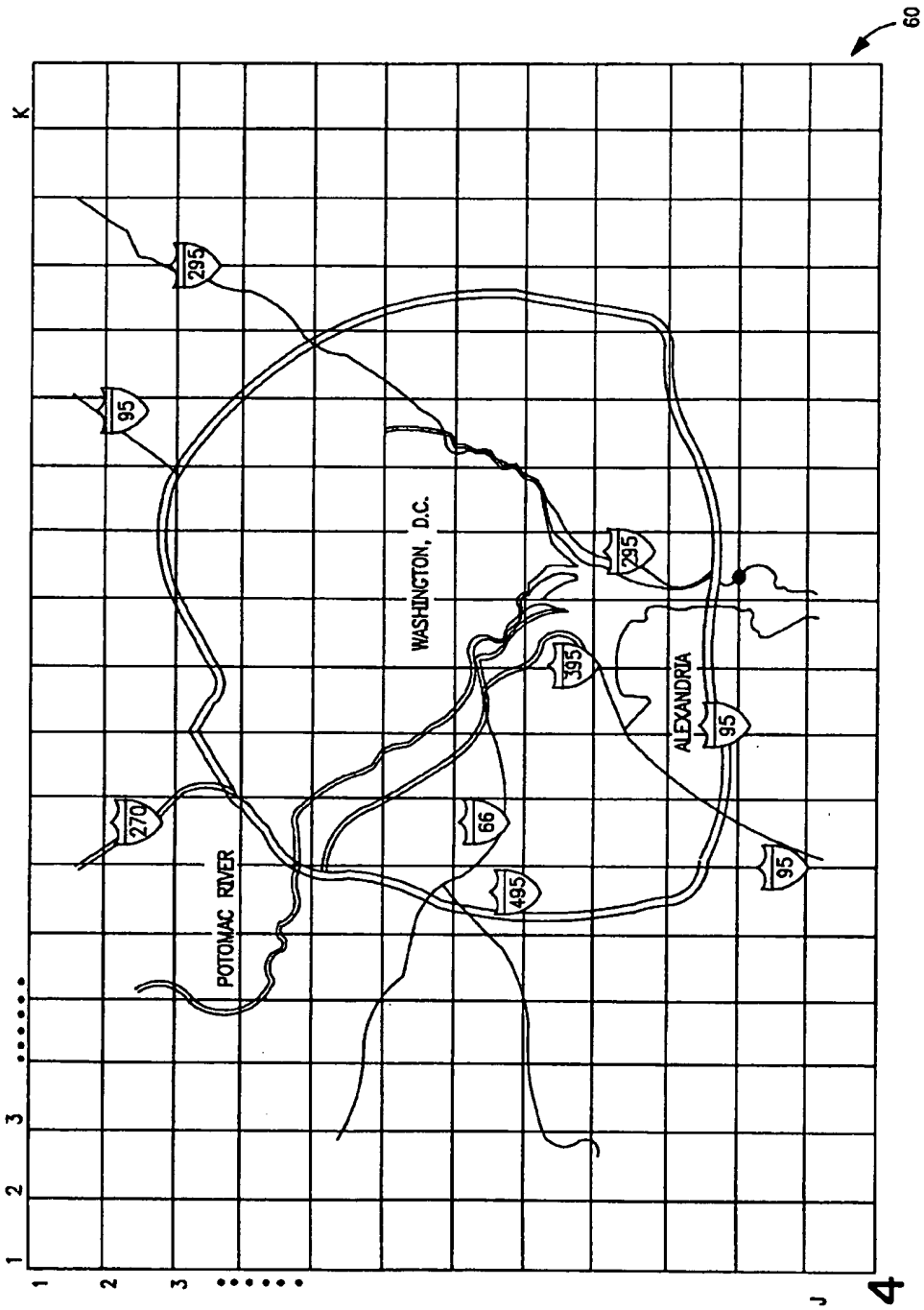

60
K
J
1
2
3
295
95
WASHINGTON, D.C.
395
ALEXANDRIA
270
66
POTOMAC RIVER
495

FIG. 4

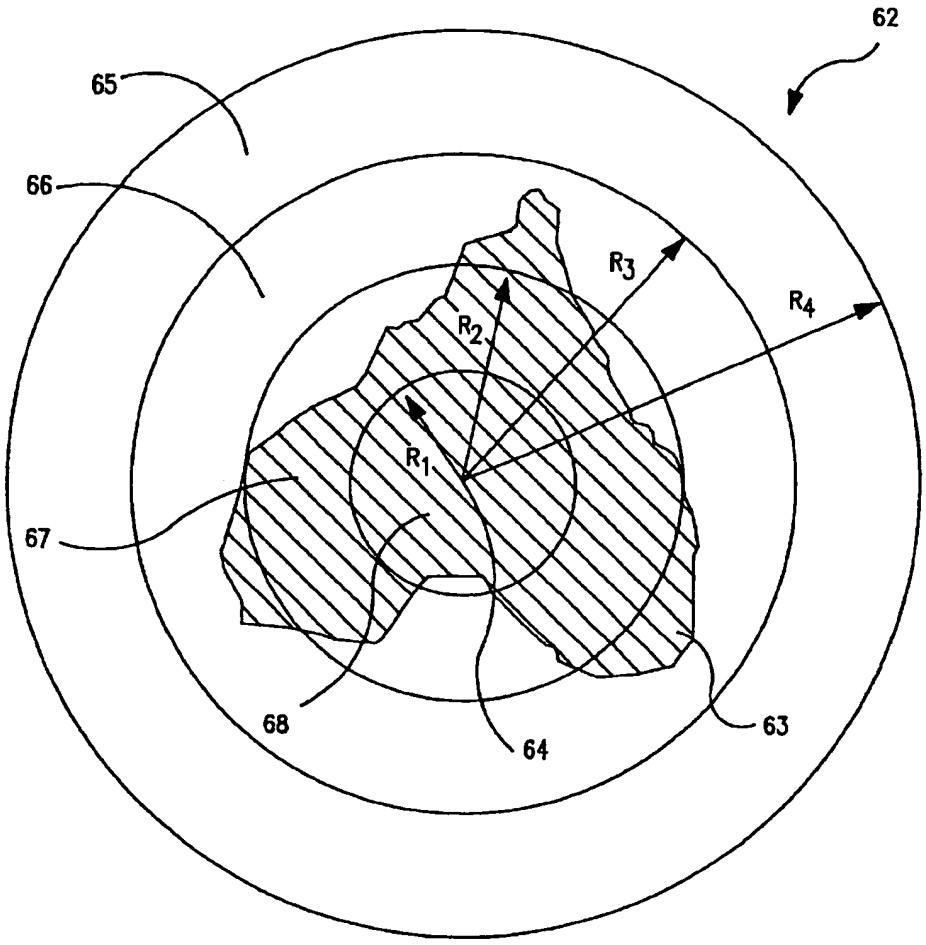


FIG. 5

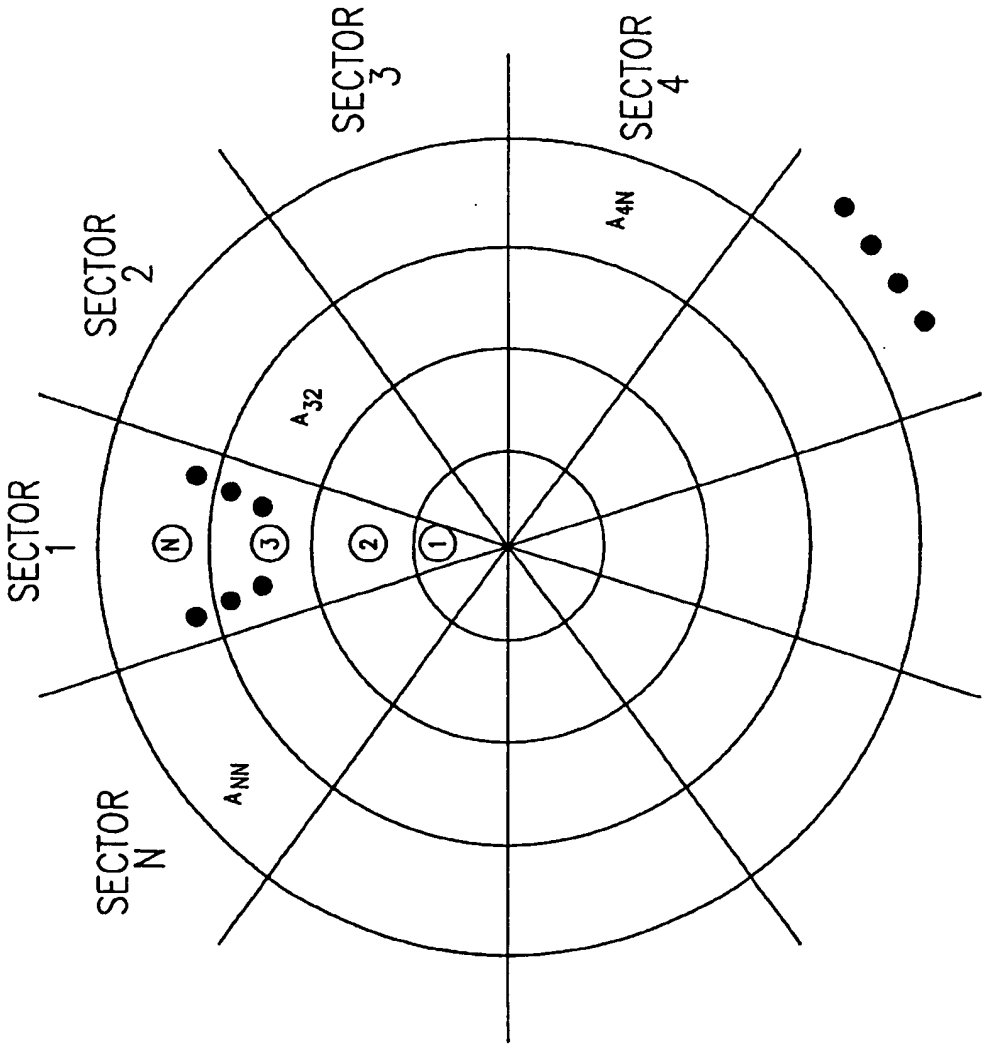


FIG. 6

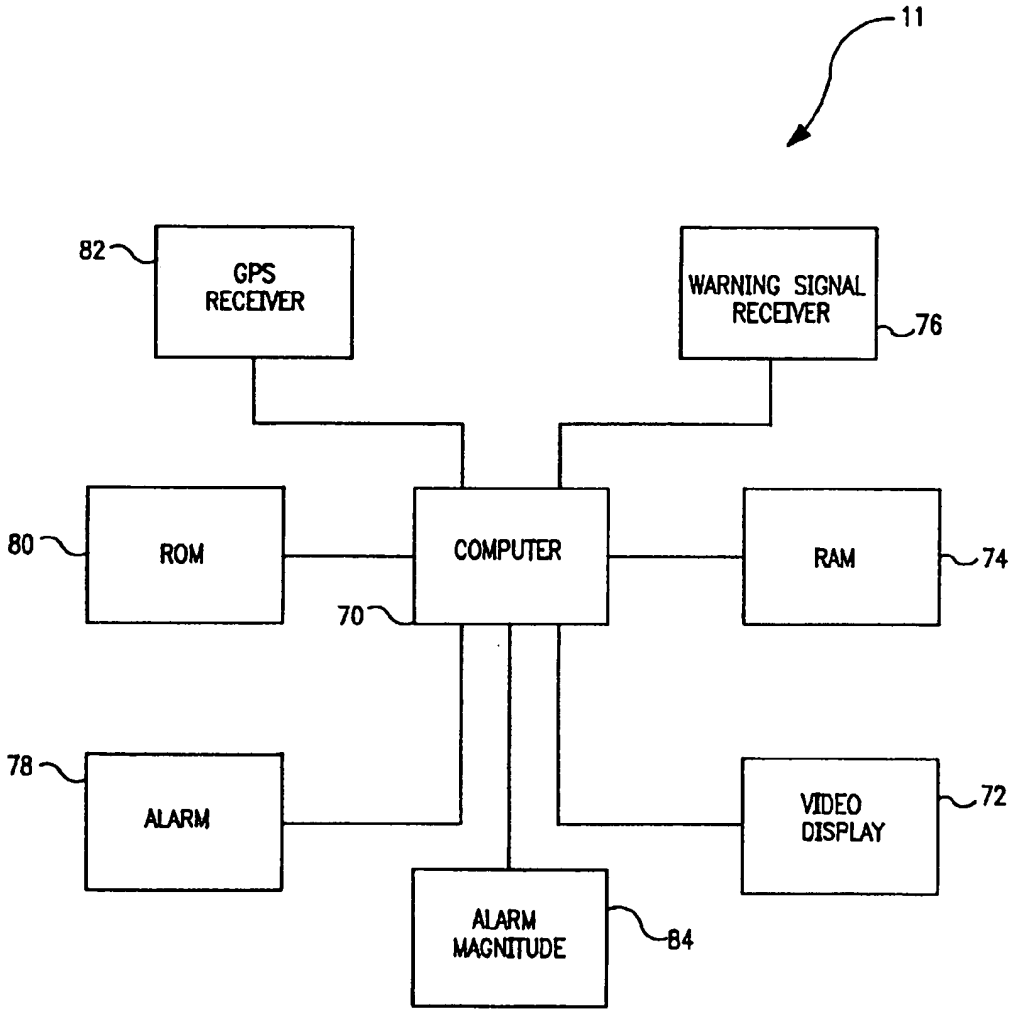

11
82
GPS RECEIVER
WARNING SIGNAL RECEIVER
76
80
ROM
COMPUTER
70
RAM
74
78
ALARM
VIDEO DISPLAY
72
ALARM MAGNITUDE
84

FIG. 7

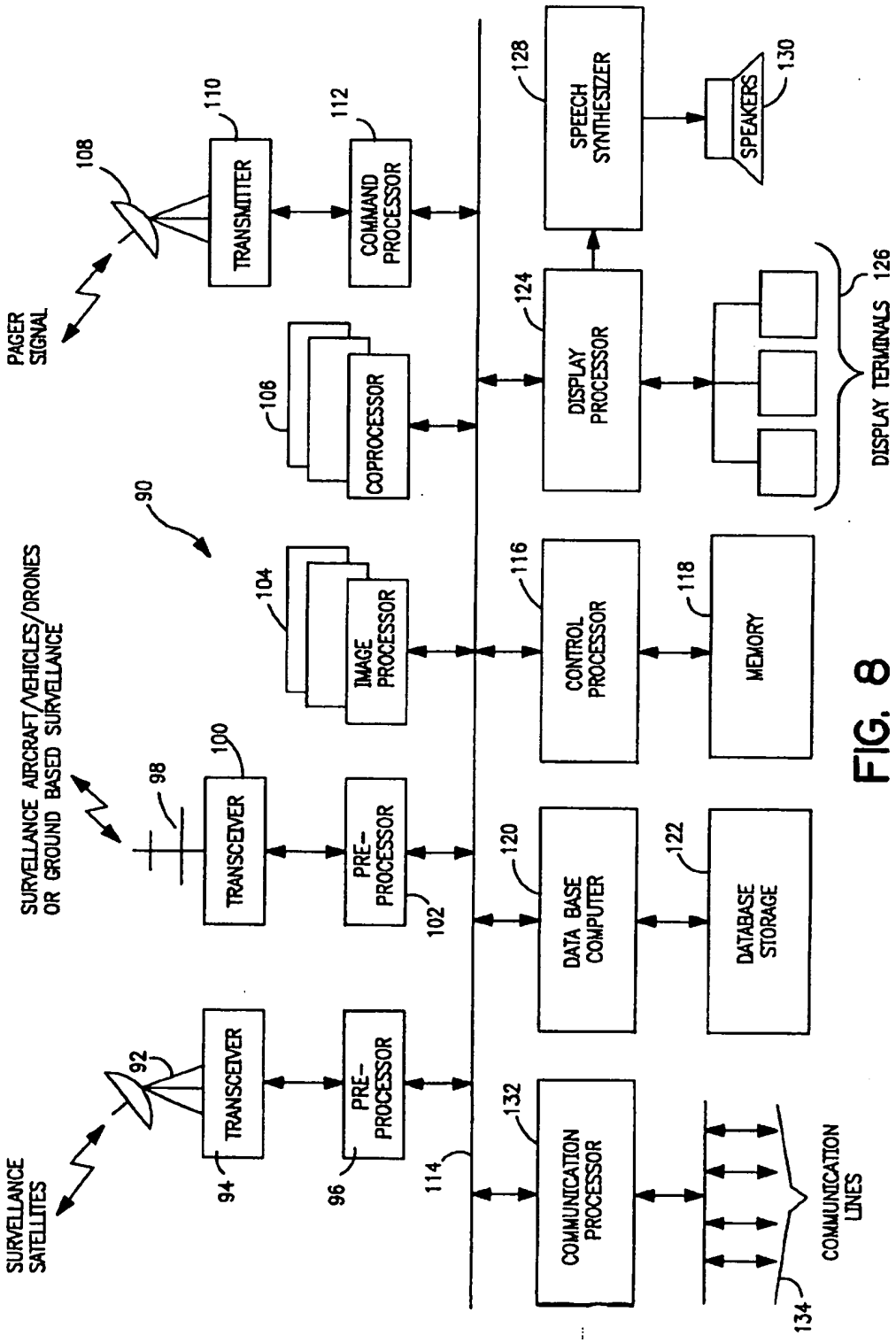

PAGER SIGNAL
108
TRANSMITTER
110
COMMAND PROCESSOR
112
SPEECH SYNTHESIZER
128
SPEAKERS
130
106
COPROCESSOR
DISPLAY PROCESSOR
124
DISPLAY TERMINALS
126
90
SURVELLANCE AIRCRAFT/VEHICLES/DRONES OR GROUND BASED SURVELLANCE
98
TRANSCEIVER
100
PRE-PROCESSOR
102
IMAGE PROCESSOR
104
CONTROL PROCESSOR
116
MEMORY
118
DATA BASE COMPUTER
120
DATABASE STORAGE
122
SURVELLANCE SATELLITES
92
TRANSCEIVER
94
PRE-PROCESSOR
96
114
COMMUNICATION PROCESSOR
132
COMMUNICATION LINES
134

FIG. 8

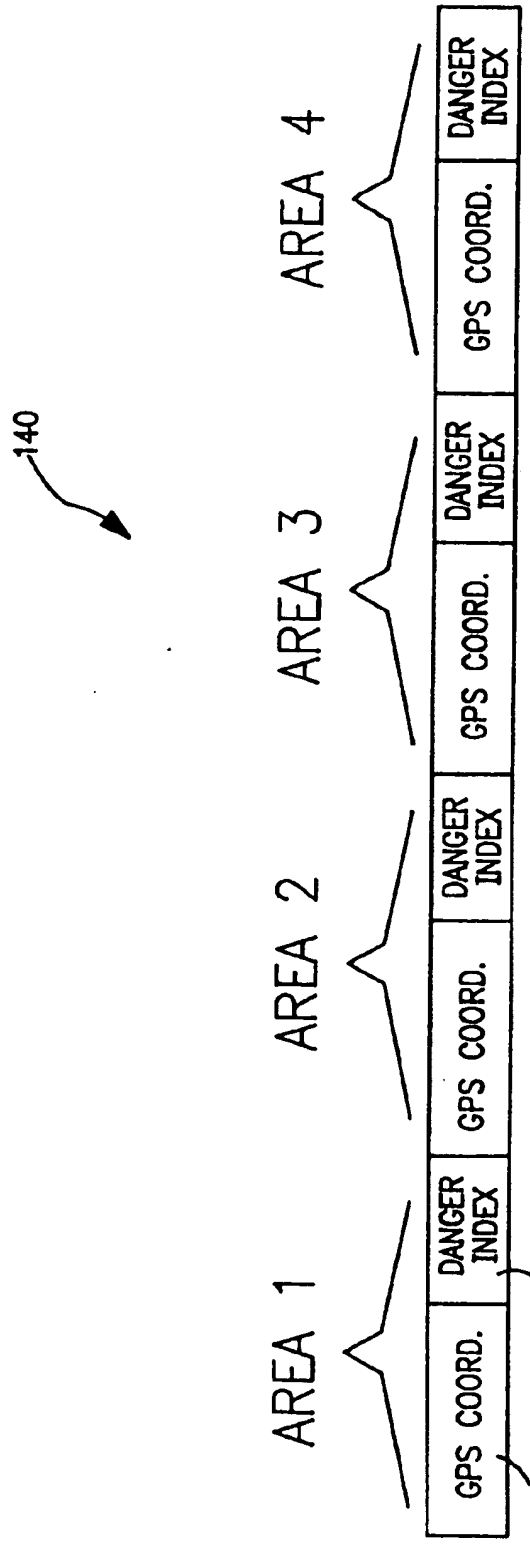

140
AREA 1
AREA 2
AREA 3
AREA 4
GPS COORD.
DANGER INDEX
GPS COORD.
DANGER INDEX
GPS COORD.
DANGER INDEX
GPS COORD.
DANGER INDEX
142
144

FIG. 9

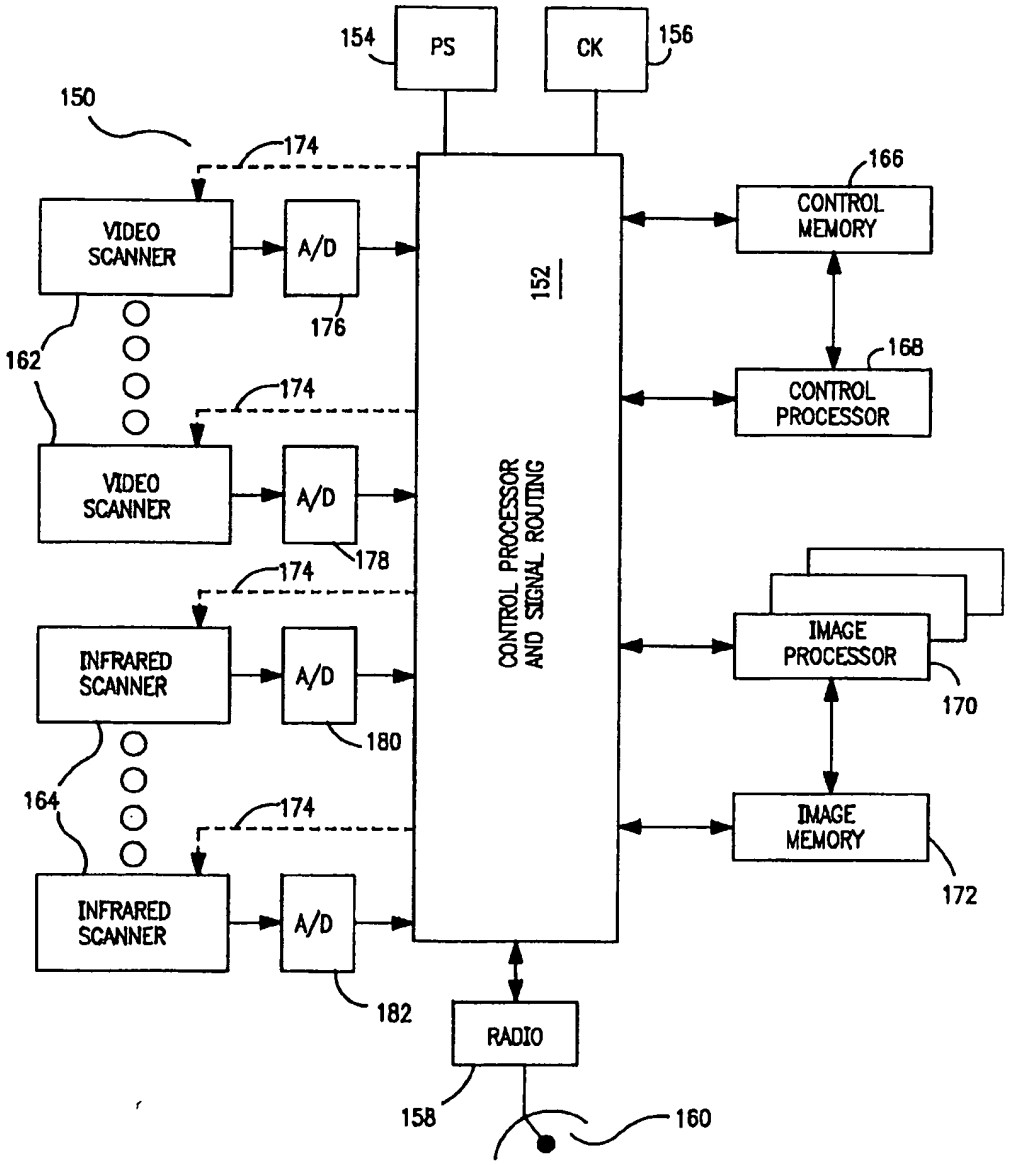

154
PS
CK
156
150
174
VIDEO SCANNER
A/D
176
162
174
VIDEO SCANNER
A/D
178
174
INFRARED SCANNER
A/D
180
164
174
INFRARED SCANNER
A/D
182
152
CONTROL PROCESSOR AND SIGNAL ROUTING
166
CONTROL MEMORY
168
CONTROL PROCESSOR
IMAGE PROCESSOR
170
IMAGE MEMORY
172
RADIO
158
160

FIG. 10

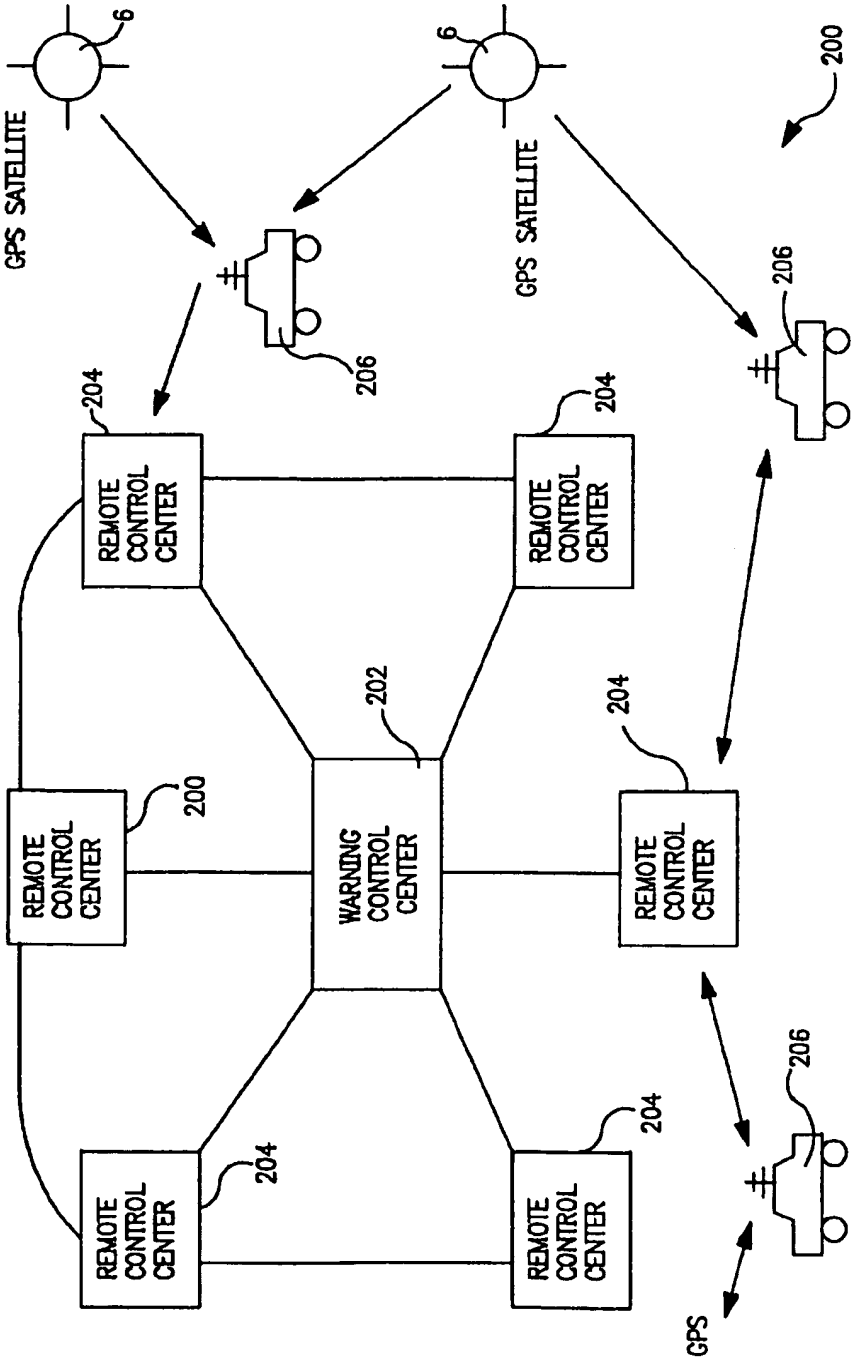

GPS SATELLITE
6
GPS SATELLITE
6
200
206
206
204
204
REMOTE CONTROL CENTER
REMOTE CONTROL CENTER
202
204
200
REMOTE CONTROL CENTER
WARNING CONTROL CENTER
REMOTE CONTROL CENTER
206
204
204
REMOTE CONTROL CENTER
REMOTE CONTROL CENTER
GPS

FIG. 11

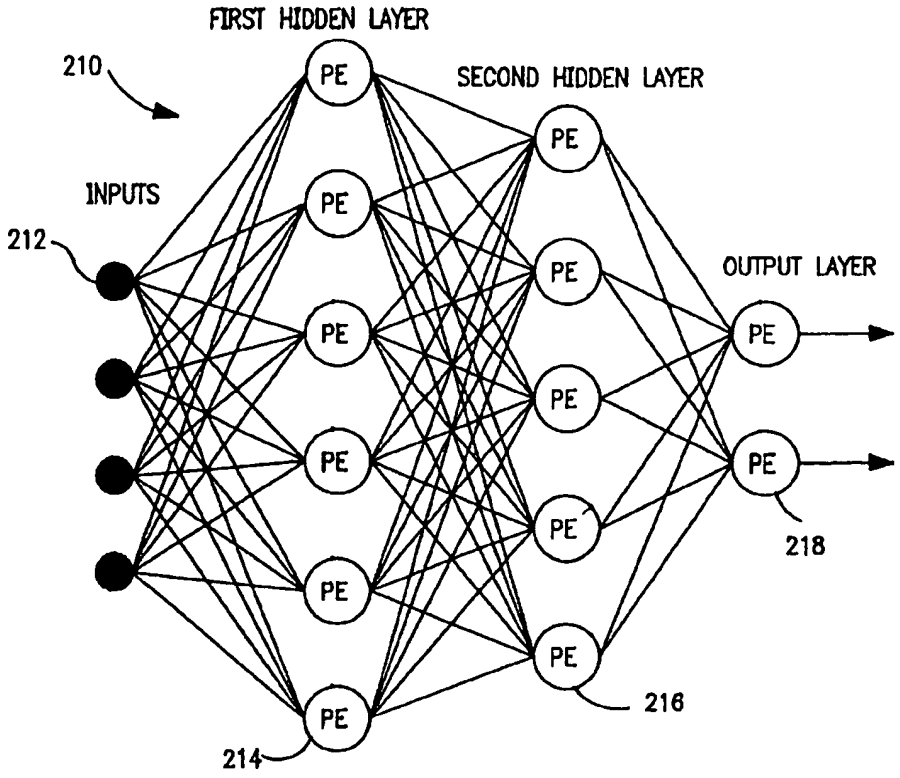

FIRST HIDDEN LAYER
210
SECOND HIDDEN LAYER
INPUTS
212
OUTPUT LAYER
PE
218
216
214

FIG. 12

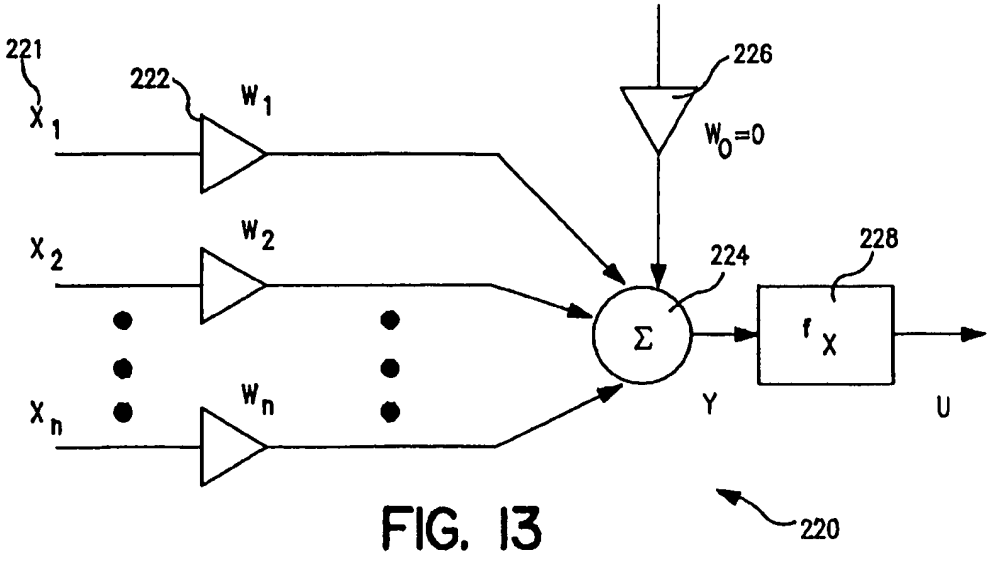

221
222
W_1
X_1
226
$W_0=0$
X_2
W_2
224
228
Σ
f_X
X_n
W_n
Y
U
220

FIG. 13

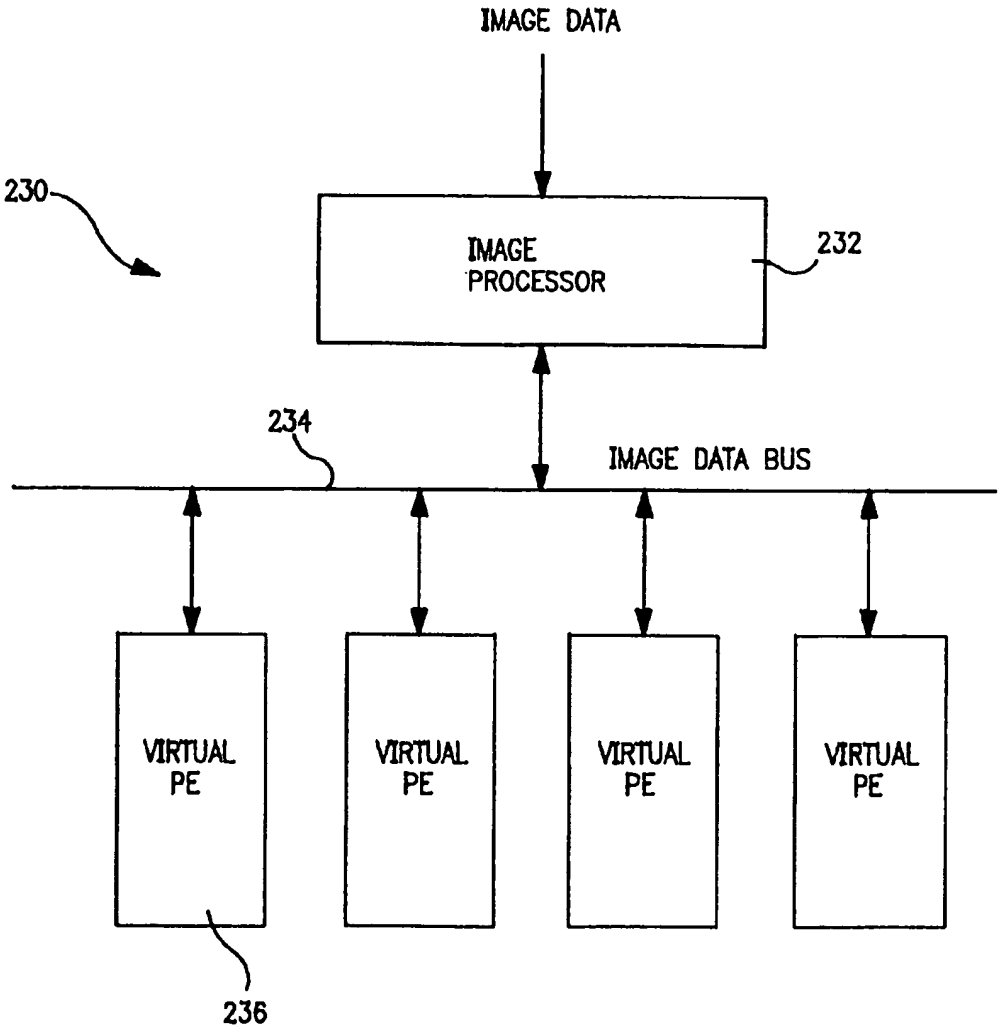


IMAGE DATA
230
IMAGE PROCESSOR
232
234
IMAGE DATA BUS
VIRTUAL PE
VIRTUAL PE
VIRTUAL PE
VIRTUAL PE
236

FIG. 14

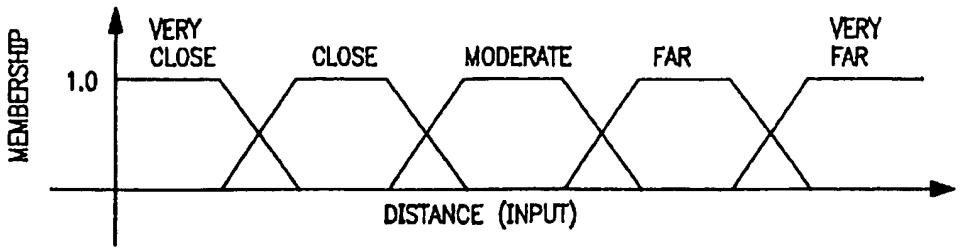


FIG. 15A

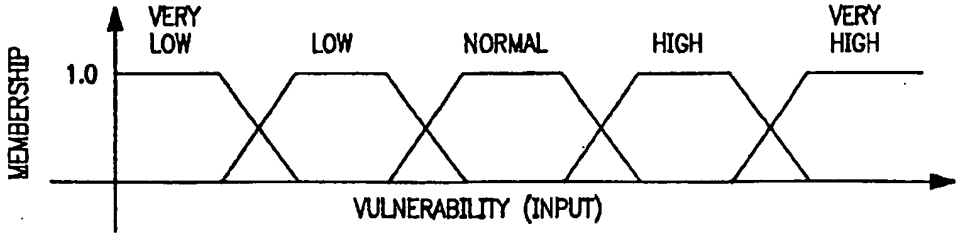


FIG. 15B

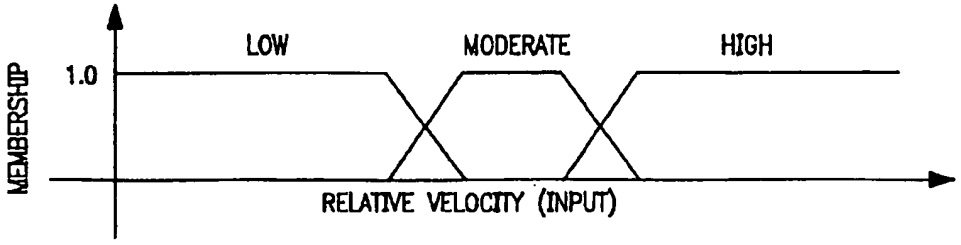


FIG. 15C

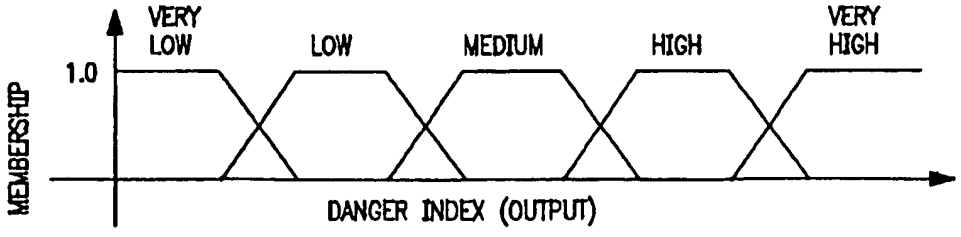


FIG. 15D

V/D= VULNERABILITY/ DISTANCE

OUTPUT= DANGER INDEX

RELATIVE VELOCITY = LOW

V/D	VC	C	M	F	VF
VL	M	L	VL	VL	VL
L	H	M	L	VL	VL
N	VH	H	M	L	VL
H	VH	H	M	M	L
VH	VH	VH	H	M	L

RELATIVE VELOCITY = MODERATE

V/D	VC	C	M	F	VF
VL	H	M	L	VL	VL
L	H	H	M	L	VL
N	VH	H	M	M	L
H	VH	VH	H	M	M
VH	VH	VH	H	H	M

RELATIVE VELOCITY = HIGH

V/D	VC	C	M	F	VF
VL	H	H	M	L	VL
L	VH	H	M	M	L
N	VH	H	H	M	M
H	VH	VH	H	H	M
VH	VH	VH	VH	H	H

FIG. 16

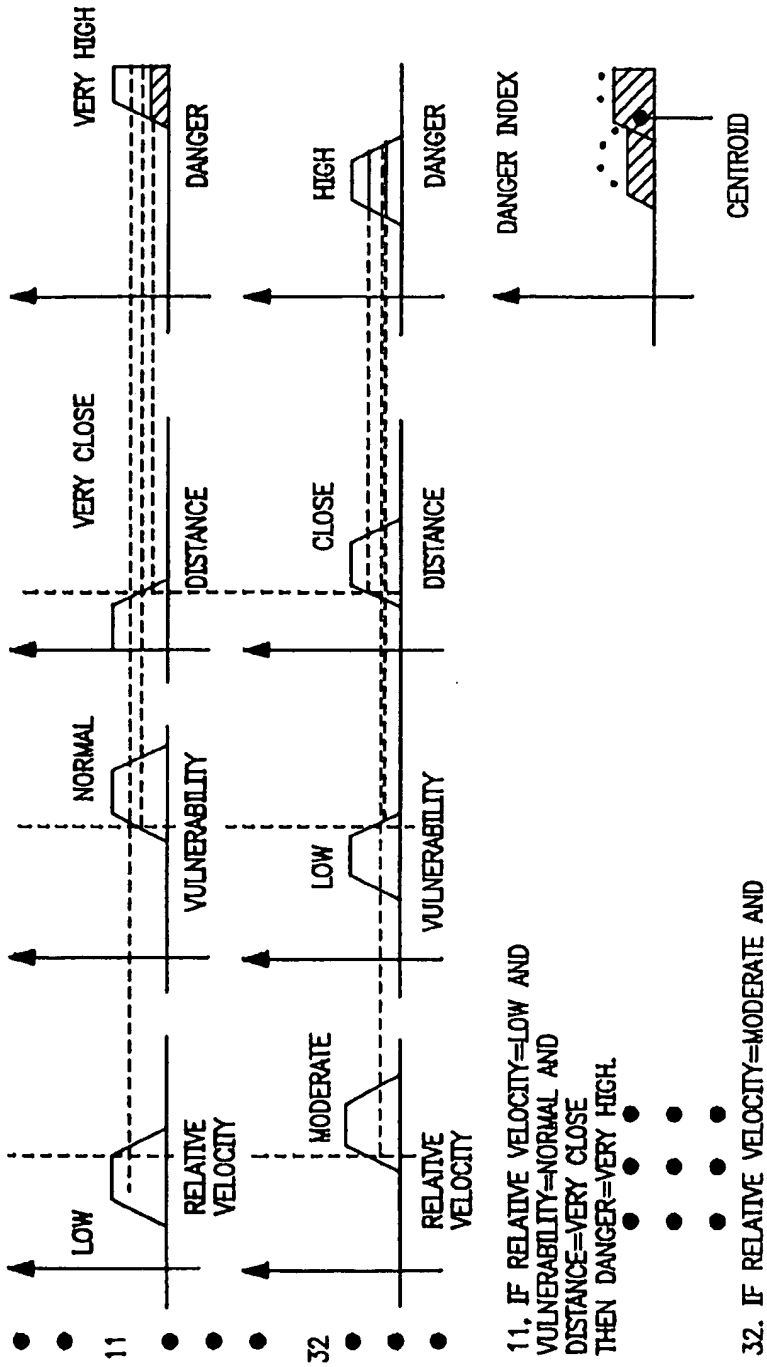

VERY HIGH
DANGER
HIGH
DANGER
DANGER INDEX
CENTROID
VERY CLOSE
DISTANCE
CLOSE
DISTANCE
NORMAL
VULNERABILITY
LOW
VULNERABILITY
LOW
RELATIVE VELOCITY
MODERATE
RELATIVE VELOCITY
11
32
11. IF RELATIVE VELOCITY=LOW AND VULNERABILITY=NORMAL AND DISTANCE=VERY CLOSE THEN DANGER=VERY HIGH.
32. IF RELATIVE VELOCITY=MODERATE AND VULNERABILITY=LOW AND DISTANCE=CLOSE THEN DANGER=HIGH

FIG. 17

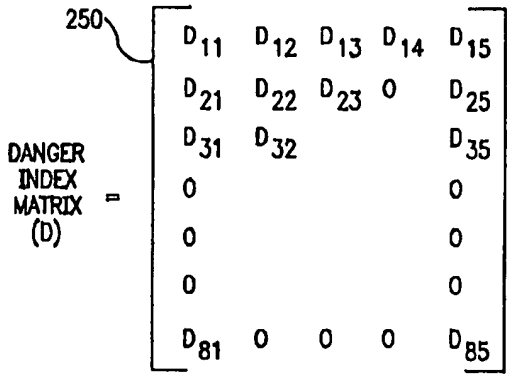


FIG. 18

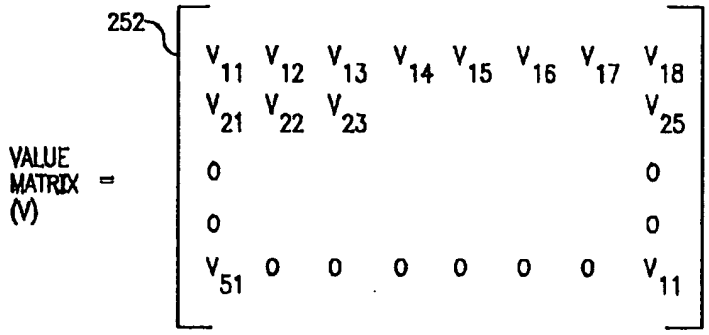


FIG. 19

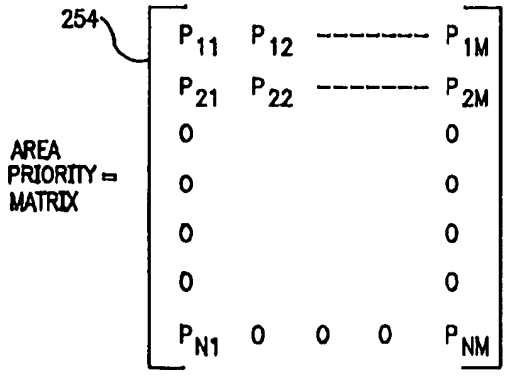


FIG. 20

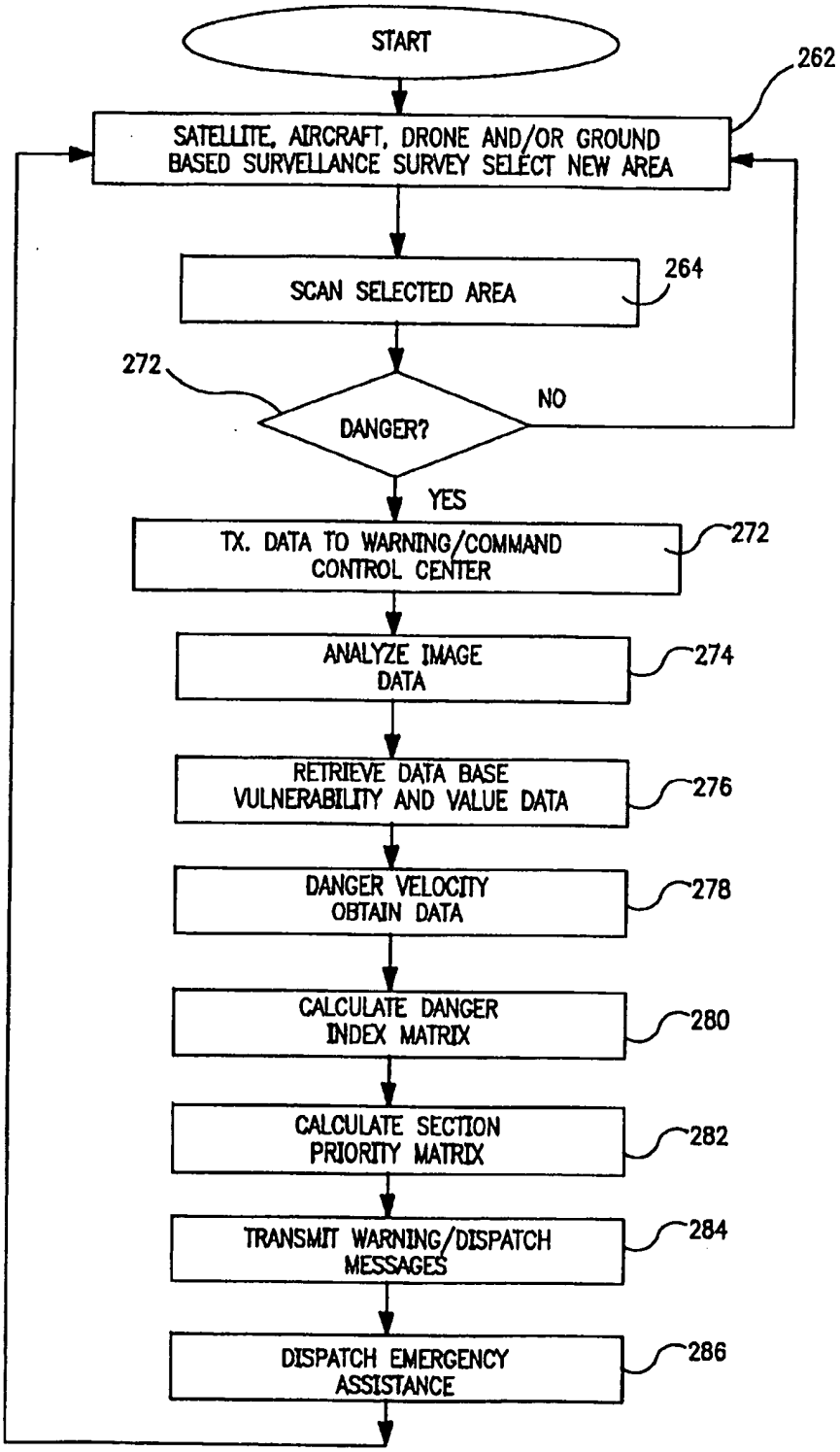

START
262
SATELLITE, AIRCRAFT, DRONE AND/OR GROUND BASED SURVELLANCE SURVEY SELECT NEW AREA
SCAN SELECTED AREA
264
272
DANGER?
NO
YES
TX. DATA TO WARNING/COMMAND CONTROL CENTER
272
ANALYZE IMAGE DATA
274
RETRIEVE DATA BASE VULNERABILITY AND VALUE DATA
276
DANGER VELOCITY OBTAIN DATA
278
CALCULATE DANGER INDEX MATRIX
280
CALCULATE SECTION PRIORITY MATRIX
282
TRANSMIT WARNING/DISPATCH MESSAGES
284
DISPATCH EMERGENCY ASSISTANCE
286

FIG. 21

DANGER WARNING AND EMERGENCY RESPONSE SYSTEM AND METHOD

This application is a continuation of application Ser. No. 08/844,029, field Apr. 18, 1997 U.S. Pat. No. 6,084,510.

BACKGROUND

These inventions relate to the field of Danger Warning and Emergency Response Systems and Methods, and more specifically, to comprehensive danger warning and emergency response systems and methods based on the use of GPS location signals used with surveillance satellites, surveillance aircraft/pilotless drones, and ground based mobile and stationary surveillance to detect dangerous situations. Information concerning dangerous situations which exist or may develop and threaten different populations of people in different areas of a county, state, or country, or a group thereof, is transmitted to a warning/command control center which, in-turn, relays broadcast warning messages via pager satellites and/or radio networks or other broadcast communication networks to remote warning devices. The warning devices may be stationary and/or may be mobile units carried in an automobile or on a person, and are responsive to warning signals directed to such devices that are located within specific geographic coordinate locations or areas as determined by the GPS location signals. Expert system technology, such as neural networks and fuzzy logic, is used to derive the emergency warning and dispatch signals.

It is often the case in our complex and advanced technological society that dangerous situations evolve which may threaten the life or property of individual or potentially many hundreds, thousands or even millions of people or to destroy or damage valuable physical assets or natural resources. Such dangerous situations commonly arise because of adverse weather conditions such as violent storms, blizzards, tornados, hurricanes, tidal waves or even extreme conditions of cold or heat. Dangerous situations may also arise because of fire, including, for example, extensive forest or range fires which may threaten populated areas or areas containing other valuable property or natural resources. Another form of dangerous situation may arise from criminal activities, such as are committed by robbers, murderers, rapists, gangs, terrorists or other thugs. In addition to criminal activity, general civil unrest and riots often give rise to dangerous situations in heavily populated areas.

Other dangerous situations that may occur include dangerous chemical spills or toxic waste emissions including emissions into the air or into a water supply or river which is relied upon by large numbers of people. Smog or bad air or other pollution alerts represent another danger we face today. Certain traffic conditions giving rise to unusual congestion and dangerous driving conditions represent another situation that people commonly encounter in our complex society. Contagious diseases may create other potentially dangerous situations that may begin in a localized region and spread outward from that region, endangering many people. Hostile military activities represent yet another dangerous situation that may threaten large population areas. Volcanic disturbances and earthquakes represent additional dangerous situations that may be monitored with the disclosed inventions.

These and other dangerous situations are frequently encountered in our society today. Increasing population densities make it even more urgent that modern technology be employed to the maximum extent to warn large segments of population of impending dangers, and, where possible, to

dispatch appropriate assistance to those areas. The need for emergency alerting systems and the possibility of implementing such systems have been recognized in recent years. Examples of such attempts are found in the following U.S. Pat. Nos.: (a) 5,278,539; (b) 4,956,857; 4,993,059; (d) 4,887,291 each of which is incorporated herein by reference in its entirety. These systems variously make use of on-premise facility alarm sensors that are used to relay warning signals to appropriate control centers via radio and/or wire line transmission links. Cellular radio links are often used for such emergency communications.

Expert system technology, including neural networks, and fuzzy logic control systems, has also been developed and adapted to a wide variety of uses. In general, expert systems using fuzzy logic inference rules are well known, as described in the following publications, each of which is incorporated herein by reference in its entirety: Gottwald, Siegried, Fuzzy Sets and Fuzzy Logic: The Foundations of Application—from a Mathematical Point of View, Vieweg & Sohn, Braunschweig Wiesbaden (1993), ISBN 3-528-05311-9; McNeil, Daniel, Fuzzy Logic, Simon & Schuster, New York (1993), ISBN 0-671-73843-7; Marks, Robert J. II, Fuzzy Logic Technology and Applications, IEEE Technology Update Series (1994), ISBN 0-7803-1383-6, IEEE Catalog No. 94CR0101-6; Bosacchi, Bruno and Bezdek, James C, Applications of Fuzzy Logic Technology, Sep. 8–10, 1993, Boston, Massachusetts, sponsored and published by the SPIE—The International Society for Optical Engineering, SPIE No. 2061, ISBN 0-8194-1326-7; Mendel, Jerry M., "Fuzzy Logic Systems for Engineering: A Tutorial", Proceedings of the IEEE, Vol. 83, No. 3, March 1995, pgs. 345–377; Jang, Jyh-Shing Roger, Sun, Chuen-Tsai, "Neuro-Fuzzy Modeling and Control", Proceedings of the IEEE, Vol. 83, No. 3, March 1995, pgs. 378–406; Schwartz, Klir, "Fuzzy Logic Flowers in Japan", IEEE Spectrum, July 1992, pgs. 32–35; Kosko, Isaka, "Fuzzy Logic", Scientific American, July 1993, pgs. 76–81; Cox, "Fuzzy Fundamentals", IEEE Spectrum, October 1992, pgs. 58–61; Brubaker, "Fuzzy Operators", EDN, Nov. 9th, 1995, pgs. 239–241.

In addition, many patents have been issued for various applications of GPS for locating and tracking objects, and for navigation purposes. Various configurations of GPS-based tracking and communication systems and methods are described in the following documents, each of which is incorporated herein by reference in its entirety: Logsdon, Tom, The Navstar Global Positioning System, Van Nostrand Reinhold, N.Y. (1992), ISBN 0-422-01040-0; Leick, Alfred, GPS Satellite Surveying, John Wiley & Sons, New York (1990), ISBN 0-471-81990-5; Hurn, Jeff, GPS—A Guide to the Next Utility, Trimble Navigation, Ltd., Sunnyvale, Calif. (1989); Hurn, Jeff, Differential GPS Explained, Trimble Navigation Ltd., Sunnyvale, Calif. (1993); and U.S. Pat. No.'s: 5,438,337; 5,434,787; 5,430,656; 5,422,816; 5,422,813; 5,414,432; 5,408,238; 5,396,540; 5,390,125; 5,389,934; 5,382,958; 5,379,224; 5,359,332 5,418,537; 5,345,244; 5,334,974; 5,323,322; 5,311,197; 5,247,440; 5,243,652; 5,225,842; 5,223,844; 5,202,829; 5,187,805; 5,182,566; 5,119,504; and 5,119,102.

While the above listed patents and known applications of GPS and fuzzy logic/expert system technology represent important innovations, none of these systems or methods take full advantage of the capability of GPS location systems used in combination with one or more earth scanning satellites, aircraft, and mobile and stationary ground based surveillance stations together with modern radio paging, cellular telephone or other broadcast communication net-

works to implement a truly wide area emergency warning and assistance dispatch system wherein a great multiplicity of people are simultaneously warned of impending or existing dangers and of the degree of danger that may be present in different geographical areas. In view of the ever-increasing occurrence of various dangerous or hazardous situations as noted above, it is critically important that these advanced technologies be brought together in an organized manner to warn various populations that may be subject to such dangerous situations.

OBJECTS OF INVENTION

It is therefore an object of these inventions to provide danger warning and emergency response systems and methods that may be operated simultaneously to warn select multitudes of people of impending dangers or disasters.

It is a further object of these inventions that the warnings received by individual people include indications of the type and degree of danger to which an individual or area is exposed.

It is yet another object of these inventions to provide such danger warning and emergency response over very large geographic areas.

Another object of these inventions to provide such danger warning and emergency response on a localized basis in a small geographic area or group of areas.

It is a further object of these inventions to provide simultaneous warnings to multiple people, with different persons receiving different warning signals depending upon the geographic location of the individuals or groups receiving the warning message or messages.

It is a further object of these inventions to provide danger warning and emergency response systems and methods that may be used for a wide range of emergency and dangerous situations including dangerous weather conditions, dangerous civil unrest, dangerous criminal activity, dangerous traffic situations, dangerous environmental situations, and dangerous medical situations and other dangerous situations that may evolve over specific geographic areas.

It is yet another object of these inventions to provide the danger warning and emergency response capability using existing radio location systems, such as GPS satellites, together with surveillance satellites and or surveillance aircraft/pilotless drones for location and danger indication purposes, and using existing pager satellites and paging systems or other emergency broadcast networks to generate warning and emergency dispatch messages.

It is yet another object of these inventions to provide a danger warning and emergency response systems and methods that may employ a range of radio signal broadcast media including broadcast television and radio signals as well as cable television, and other land based cable and or fiberoptic communications networks to broadcast warning signals to individual warning devices.

It is yet another object of these inventions is to make use of expert system technologies such as fuzzy logic using fuzzy inference rules to generate danger indices depending upon the location of the dangerous situation, the direction of movement of the dangerous situation, the vulnerability of individuals, and the distance of individuals from the dangerous situation.

A further object of these inventions is to provide danger warning and emergency response systems and methods that make use of neural network analysis of image and/or surveillance information to detect particular types of dangerous situations.

Further objects of the invention are apparent from reviewing the summary of the invention, detailed description and dependent claims which are set forth below.

SUMMARY OF INVENTION

One aspect of the invention is a method of providing an automated, wide-area, danger warning and emergency which includes the steps of (a) detecting a dangerous situation from a detection location, (b) transmitting information signals describing the dangerous situation from the detection location via radio transmission signals to a control center for analysis, analyzing the received information signals in the control center in computer systems employing expert system technology, (d) determining in the control center the degree of danger and its geographic extent based on analysis of the received information signals, (e) generating in the control center a danger warning and emergency response including a danger index indicating a degree of danger within at least one geographic area, (f) broadcasting the danger warning and emergency response from the control center to a plurality of remotely located warning devices each of which has a GPS receiver and the ability to calculate its own location in GPS coordinates, (g) receiving via the broadcast signals the danger warning and emergency response in the remotely located warning devices, and comparing in each remotely located warning device the coordinates of the dangerous situation with its own GPS coordinates for determining the extent to which each remotely located warning device is in danger, and (h) automatically issuing from each remotely located warning device a warning corresponding to the extent to which the issuing remotely located warning device is in danger.

The wide-area coverage of the present invention includes multiple population areas, nation-wide areas or world-wide areas or selected areas thereof.

Other features of this aspect of the invention include surveying the earth from one or more surveillance platforms supported on satellites, airborne craft, balloons or ground based mobile vehicles or stationary structures, and surveying the earth with any one or more of conventional equipment or personnel supported on the platform including video scanning cameras, infrared scanners, chemical detectors, infrared detectors or sensors, image or surveillance signal analyzers, neural networks, high speed vector processing or parallel processing systems, or human surveyors. Preferably each of the platforms has a GPS receiver which determines the GPS coordinates of its supporting surveillance platform, and estimates the GPS coordinates of the detected danger when laterally offset therefrom. These GPS coordinates of the surveillance platform are included in the transmission to the control center.

Still other features of this aspect of the invention are analyzing by employing fuzzy logic and fuzzy inference rules, and using expert knowledge database retrieval and relating the stored database information to the type of danger and the location of dangerous situations.

Still other features of this aspect of the invention are defining the geographic extent of danger in GPS coordinates, defining the geographic extent of the danger as bounded by the radii of two circles centered on a dangerous situation whose center is defined by GPS coordinates, and as bounded by angular sectors between the radii.

Other features of this aspect of the invention include deriving the danger index from parameters including the distance between the dangerous situation and a particular warning device, the rate at which the dangerous situation

may be approaching a particular warning device, the vulnerability of a person or property associated with a particular warning device to a particular dangerous situation, and the type of a particular dangerous situation; defining a vulnerability index for a particular area depending upon the presence of a particular structure, natural resource, or population density of the area; and establishing an emergency response dispatch priority using vulnerability factors characterizing different geographic regions. Thus, a dispatch priority may be established by analyzing the vulnerability of a particular structure to one type of a dangerous situation, such as, violent weather situations or earthquakes of various types, and the vulnerability of people to another type of dangerous situation, such as, radiation or disease.

Another feature of this aspect of the invention includes displaying and communicating by visual, wire, voice, synthetic speech, sound or other conventional alert devices in the control center, which may be a warning and command type control center, the results of the surveillance and analysis of signals received from the detection locations or surveillance platforms to alert an operator thereof of the dangerous situation in the surveyed region or regions.

Still further features of this aspect of the invention include transmitting the danger warning and emergency response via a radio link to a pager satellite network or to a ground based pager network or to a ground based broadcast network, and then to the warning device.

Further features of this aspect of the invention include transmitting messages containing a plurality of danger indices and geographic coordinates identifying the regions corresponding to each danger index, identifying predefined danger emergency warning areas and a danger index for each such area relative to an identified dangerous situation and the degree of danger it represents, and broadcasting to remote warning devices located on persons, in mobile land vehicles, in airborne craft, on vessels at sea, or in stationary structures.

Still further features of this aspect of the invention include the remotely located warning device determining that it is located within the geographic area defined by the GPS coordinates of the dangerous situation, and, then, activating warning signals indicating the degree of danger which was communicated via the danger index in the received signals. Depending upon the location of the remotely located warning device, different degrees of danger exist relative to the nature of the dangerous situation as indicated by the received broadcast signals, and if, on one hand, the remotely located warning device be located within a geographic area defined as having a very high danger, then that device will indicate via an audible, visual, vibratory or other warning device the existence of a very dangerous situation, whereas, if, on the other hand, the warning device be located in an area adjacent to a very dangerous situation, then that device will indicate via an audible, visual, vibratory or other warning device the existence of a less than very dangerous situation.

Another aspect of the invention includes receiving the danger warning and emergency response in a control center remote from the warning command control center which dispatches and controls emergency response services to assist in alleviating the dangerous situation. The dispatching of emergency services may be based on a priority index derived from both danger and value indices.

Another feature of this aspect of the invention includes receiving the broadcast danger warning and emergency response directly in emergency response vehicles manned by emergency personnel located in the most dangerous areas who, upon decoding the danger warning and emergency response will immediately know that they are in the proximity of the dangerous situation and may immediately respond accordingly, and determining the locations of such emergency response vehicles or persons by using GPS technology.

Another aspect of the invention includes broadcasting the danger warning and emergency response via a conventional communication network television, AM/FM radio, cable, and fiber optic networks. As before, so, too, this aspect of the invention includes receiving a danger index including geographic coordinates defining regions appropriate to each degree of danger corresponding to the geographic area in which the receiver which may include, for example, a television set, a computer, or a radio receiver is located indicating the degree of danger in which users located in particular areas may find themselves. Where the remotely located warning device may be a television set, the invention includes, receiving in the television set the danger warning and emergency response, displaying on the display screen of the television set an emergency message customized to the location of the television, and identifying in the emergency message the danger and its position from the television display screen based on information resulting from a comparison of electronic data from different sources occurring within the television set. Where the remotely located warning device is a radio receiver the invention includes receiving on the radio receiver the danger warning and emergency response, annunciating from the radio an emergency message customized to the location of the radio or radio receiver, and identifying in the emergency message the danger and its position from the radio annunciator based on information resulting from a comparison of electronic data from different sources occurring within the radio receiver.

Additional features of the present invention include maintaining selected ones of the remotely located warning devices in a stand-by mode, transmitting from the control center control signals to said selected ones of the remotely located warning devices to switch from a stand-by mode to a full-receive mode enabling receiving messages from the control, and short wave transmitting codes from the remotely located warning devices back to the control center indicating that the selected danger warning signals have been received.

The preferred embodiments of the inventions are described below in the Figures and Detailed Description. Unless specifically noted, it is applicant's intention that the words and phrases in the specification and claims be given the ordinary and accustomed meaning to those of ordinary skill in the applicable art(s). If applicant intends any other meaning, he will specifically state he is applying a special meaning to a word or phrase.

Likewise, applicant's use of the word "function" in the Detailed Description is not intended to indicate that he seeks to invoke the special provisions of 35 U.S.C. Section 112, paragraph 6 to define his invention. To the contrary, if applicant wishes to invoke the provision of 35 U.S.C. Section 112, paragraph 6, to define his invention, he will specifically set forth in the claims the phrases "means for" or "step for" and a function, without also reciting in that phrase any structure, material or act in support of the function. Moreover, even if applicant invokes the provisions of 35 U.S.C. Section 112, paragraph 6, to define his invention, it is applicant's intention that his inventions not be limited to the specific structure, material or acts that are described in his preferred embodiments. Rather, if applicant

claims his invention by specifically invoking the provisions of 35 U.S.C. Section 112, paragraph 6, it is nonetheless his intention to cover and include any and all structures, materials or acts that perform the claimed function, along with any and all known or later developed equivalent structures, materials or acts for performing the claimed function.

For example, the present inventions generate surveillance image information for analysis by scanning using any applicable image or video scanning system or method. The inventions described herein are not to be limited to the specific scanning or imaging devices disclosed in the preferred embodiments, but rather, are intended to be used with any and all applicable electronic scanning devices, as long as the device can generate an input signal that can be analyzed by a computer to detect dangerous situations. Thus, the scanners or image acquisition devices are shown and referenced generally throughout this disclosure, and unless specifically noted, are intended to represent any and all devices appropriate to scan or image a given area.

Likewise, it is anticipated that the physical location of the scanning device is not critical to the invention, as long as it can scan or image the surveillance area or region. Thus, the scanning device can be configured to scan from satellites, aircraft, pilotless drones, or from ground based vehicles or structures as appropriate. Accordingly, the words "scan" or "image" as used in this specification should be interpreted broadly and generically.

Further, there are disclosed several computers or controllers, that perform various control operations. The specific form of computer is not important to the invention. In its preferred form, applicant divides the computing and analysis operations into several cooperating computers or microprocessors. However, with appropriate programming well known to those of ordinary skill in the art, the inventions can be implemented using a single, high power computer. Thus, it is not applicant's intention to limit his invention to any particular form of computer.

Further examples exist throughout the disclosure, and it is not applicant's intention to exclude from the scope of his invention the use of structures, materials, or acts that are not expressly identified in the specification, but nonetheless are capable of performing a claimed function.

BRIEF DESCRIPTION OF THE DRAWINGS

The inventions of this application are better understood in conjunction with the following drawings and detailed description of the preferred embodiments. The various hardware and software elements used to carry out the inventions are illustrated in the attached drawings in the form of block diagrams, flow charts, and neural network and fuzzy logic algorithms and structures.

FIG. 1 is a diagram illustrating the overall danger warning and emergency response system and method used to alert via warning devices multitudes of people of dangerous situations and the degree of danger individual persons or areas may be in based on their geographical location.

FIG. 2 is an exemplary emergency area warning system map using a rectangular grid to identify particular regions within which warning devices may exist.

FIG. 3 is an exemplary emergency area warning system overlaid on a map of the United States, with a more detailed map of the state of Alaska.

FIG. 4 is yet another example of an emergency area warning map using a rectangular grid to define specific areas within the city of Washington D.C.

FIG. 5 is an exemplary emergency area warning system map using a circular grid to identify particular concentric ring regions within which warning devices may exist.

FIG. 6 is an example of a circular grid like FIG. 5 with additional defined angular sectors to further localize warning devices and dangerous situations.

FIG. 7 is a block diagram of a warning device useful in the present inventions.

FIG. 8 is a block diagram illustrating the configuration of a warning control center useful in the present inventions.

FIG. 9 illustrates the structure of a broadcast danger index message useful in the present invention.

FIG. 10 is a block diagram of a danger detection surveillance satellite or aircraft configuration.

FIG. 11 illustrates an emergency warning/response dispatch system making use of information generated using the inventions herein disclosed.

FIG. 12 is a diagram illustrating a structure of a neural network useful in analyzing image and/or other surveillance information to derive information characterizing dangerous situations.

FIG. 13 illustrates the structure of a processing element in the neural network of FIG. 12.

FIG. 14 illustrates an alternate embodiment of the neural network analysis processor.

FIG. 15 illustrates an example of fuzzy logic membership functions for various parameters useful in evaluating a danger index using fuzzy logic inference rules.

FIG. 16 illustrates an example of danger index fuzzy logic inference rules.

FIG. 17 is an example of fuzzy logic danger index calculations indicating graphically the manner in which such calculations are made using a multiplicity of fuzzy logic variables.

FIG. 18 is an area danger index matrix useful in the danger warning and emergency response system and method herein disclosed.

FIG. 19 is a area value matrix useful in the systems and methods herein disclosed.

FIG. 20 is an area priority matrix useful in defining the priorities of particular areas for emergency response.

FIG. 21 is a danger warning dispatch/process flow diagram.

The above, figures are better understood in connection with the following detailed description of the preferred embodiments.

DETAILED DESCRIPTION

Detecting Dangerous Conditions by Surveillance

FIG. 1 illustrates the danger warning and emergency response system and method in accordance with the present inventions. The systems and methods employ surveillance satellites 8 and surveillance aircraft/pilotless drones 10 to monitor and survey areas on earth for dangerous situations and occurrences of threatening events. The surveillance satellites 8 and surveillance aircraft/pilotless drones 10 may make use of standard video scanning techniques, infrared scanning techniques or other surveillance methods to search the earth for dangerous situations. Multiple surveillance satellites 8 may be used to cover large areas of the earth. Different camera types may be used including cameras adapted for wide area coverage and cameras able to focus on very small detailed areas and deliver pictures of those areas

to ground based facilities. A great multiplicity of surveillance aircraft/drones **10** may be used with pilotless drones being particularly useful in surveying areas such as dense forest or remote geographic locations for problems that may threaten natural resources. In addition to the surveillance aircraft and surveillance satellites illustrated in FIG. 1, other airborne surveillance equipment may be used including, for example, the use of properly equipped surveillance balloons.

Surveillance of the earth for dangerous situations is also carried out using ground based mobile surveillance units **12** and ground based stationary surveillance units **14** as also illustrated in FIG. 1. Mobile units may include ordinary police patrols and fire patrols as well as other civil agency operations including forest service personnel and municipal employees. Ground based stationary surveillance **14** may include surveillance cameras located in buildings or other structures as well as fire detectors, smoke detectors, chemical detectors, and other types of fixed stationary surveillance devices used to detect various types of dangerous situations.

Transmitting Surveillance Results to Control Center

The surveillance platforms, including satellites **8** and surveillance aircraft/drones **10** along with the ground based mobile surveillance **12** and ground based stationary surveillance **14**, transmit the results of their area surveillance directly **22**, **22***a*, **22***b*, **24** to the warning command/control center **2** of FIG. 1. Alternatively, they may transmit **22***c*, **22***d*, **22***e* their signals via satellites **8** for relay **22** to the control center. Such signals may include video pictures, indications from various types of warning devices, verbal messages from surveillance personnel or other types of message information useful to the warning command/control center **2** in analyzing the dangerous situations. The surveillance platforms may communicate with the control center using a cellular network having a voice/data channel as is well known in the communications industry.

The Remotely Located Warning Devices and GPS

Also shown in FIG. 1 is the warning device **11**, including a short wave receiver **11***a*, which may be carried by individuals or located in moving vehicles such as automobiles, trucks, ships at sea, or aircraft. Such warning devices, including a television **17***a* or radio **17***b* or a computer-receiver, may also be located in stationary buildings or physical structures **17**. The warning device **11**, **11***a*, **17***a*, **17***b* includes a GPS receiver capability for receiving GPS location signals **28**, **28***a*, **28***b* from multiple GPS satellites **6**. As is well known in the art, such signals enable precise location calculation for the warning device **11** any place on the earth using the principles of triangulation based on the receipt of signals from multiple GPS satellites. GPS satellites **6** also transmit signals **26**, **26***a*, **30**,**30***a* to the airborne **8**,**10** and ground based mobile **12**, **14** surveillance units for use in locating these units in the overall danger warning and emergency response systems and methods of the present inventions. The surveillance platforms having GPS receivers on board can transmit the results of their surveillance using their own GPS coordinates if they are experiencing or close aboard the danger themselves. Otherwise, their own GPS coordinates may be used as a basis for estimating the GPS coordinates of the danger when the danger is laterally offset from the present position of the reporting surveillance platform.

The Control Center Transmitting Information Signals to the Remotely Located Warning Devices

Using signals from the GPS satellites, the warning device **11**, **11***a*, **17***a*, **17***b* knows its precise coordinates and may use this information in cooperation with the warning command/control center **2** to determine whether or not the warning device **11** is in a dangerous situation, and, if so, to what degree that danger exists. The warning command control center **2** transmits via radio link **18** information signals to pagers satellites **4** and/or, alternatively, to ground based pager networks or other broadcast networks, control messages indicating the degree of danger in different geographic areas on the earth. These signals are in turn transmitted via radio links **20** to the warning devices **11** as illustrated in FIG. 1. The control centers **2** may have their own GPS receiver for receiving GPS signals **26***b* and may transmit all location coordinates as GPS based coordinates derived from their on board GPS receivers or from the GPS receivers in the surveillance platforms.

Warning Devices Computing Danger to Self

Using the warning signals from pager satellites **4**, computers in the warning device **11** may compare the coordinates of the warning device **11** with particular areas designated as being dangerous in the signals from the pager satellite **20**. The signals from the warning command/control center **2** relayed via pager satellite **4** will indicate for multiple areas different degrees of danger depending upon the nature of the incident detected. For example, all warning devices located within one mile of a criminal activity may receive a high danger warning signal. By transmitting the geographic coordinates of the area of concern, the warning device **11** may determine whether or not it is located in the high danger area. Similarly, the warning command/control center **2** will transmit via relay pager satellite **4** signals indicating a lesser degree of danger in areas adjoining the area designated as a high danger vicinity. For example, in the case just cited, for warning devices within an area from 2 miles to 3 miles of the criminal activity, the warning device **11** may calculate that it is in an area of moderate danger. Thus, knowing its GPS coordinates enables the warning device **11** to compute the extent to which it is in danger based upon the signals received from the warning command/control center **2** relayed via the pager satellite system **4** of FIG. **1**.

In addition to using the warning device **11**, the systems and methods of FIG. **1** illustrate transmission **18***b* via auxiliary TV/radio broadcast stations **16** of the warning messages of the present inventions. These messages, in-turn, may be relayed to any radio receiver **17***b* or television receiver **17***a* or other information indicating device within the range of the auxiliary TV/radio broadcast station **16** of FIG. **1**. Alternatively, short wave radio transceivers **11***a* may receive short wave transmissions **18***c*. Such radio receivers and TV sets can be equipped with GPS receivers to receive GPS signals **28***a*, **28***b*, or, alternatively, have their location coordinates determined by other conventional devices, such as, radio ranging systems, optic systems, or the like, entered by users. These local location coordinates may be compared with received coordinates corresponding to areas of various degrees of danger in the same manner as used by the warning device **11** and described above. Thus, not only do the portable warning and information indicating devices **11**, **11***a*, **17***a*, **17***b* become available for warning of dangerous situations, but all such radio receivers and television receivers and receiver-computers so equipped would be able to present and display information to alert many people simultaneously.

It will thus be appreciated that through the present invention large multitudes of people may be readily warned of the dangerous situation in which they find themselves. For

example, subscribers to a paging system may be immediately warned of a danger. Through them, such alerted persons may readily inform other alerting services nearby, such as, local police or T.V. stations (when the latter are not directly alerted by this invention) who may then alert still larger masses of people through their large mass communication networks. As an additional mode of using this invention, the surveillance device may detect people stranded at sea, such as, shipwrecked or disabled craft, and automatically alert the nearest sea and aircraft for help.

Control Center's Surveillance Area Maps and Computation of Danger Indices

FIG. 2 illustrates an example map for a surveillance area 50 typically located at the control center. In this example, the area is divided into rectangular sectors indicated with the row numbers 1 through 5 and the column numbers 1 through 8. The dangerous situation 52 is primarily in quadrant row 3 column 4 but also extends into adjacent quadrants as illustrated in the figure. In addition, the dangerous situation, identified by the surveillance platform and plotted on the map, is moving in the direction indicated by arrow 54 with a determinable velocity. The dangerous situation 52 may be, for example, a fire, an area of civil unrest, an area of criminal activity, an area adversely effected by weather, an area of military activity, an area endangered by flooding waters, or an area with a outbreak of disease.

a. Predefined Danger Emergency Warning Area Maps

As indicated in FIG. 2, each of the rectangular sectors in the survey area 50 has been graded by the control center with a danger index relative to a particular identified dangerous situation. The following indices are used in this example:

VL=Very Low

L=Low

M=Moderate

H=High

VH=Very High

It can be seen from examination of FIG. 2 that the areas immediately effected by the dangerous situation 52 are given the "Very High" danger index. Regions surrounding those in very high danger areas are given a "High" danger index, with the exception of areas out of the direction of travel of the disaster which are given a danger index of "Moderate". Progressing outward from the dangerous situation 52, lower degrees of danger exist as indicated by the danger indices in the various rectangular sectors of FIG. 2.

Also indicated in FIG. 2 are multiple warning devices 11 of the type depicted in FIG. 1. These devices are located in different rectangular quadrants as shown in the figure. Of course, depending upon the distribution of population, vehicles or other structures with warning devices, any individual rectangular sector of FIG. 2 may have many warning devices 11. As shown in FIG. 1 and discussed above, the warning devices 11 receive information signals, i.e., danger warning and emergency response dispatch messages, via the broadcast communication system, for example, pager satellite 4 via radio links 20 of FIG. 1. Each warning device 11 also receives location signals, for example, from GPS satellites 6 as indicated in FIG. 1. Using the GPS location signals, each warning device 11 of FIG. 2 computes its exact location on the surface of the earth. Also, with the warning danger and emergency response information signals received from the pager satellite 4 of FIG. 1, the warning devices 11 of FIG. 2 are able to readily identify sectors and the boundaries of particular sectors in FIG. 2 and the danger index for each sector which was transmitted from the control center via the pager satellite 4 or other broadcast network of FIG. 1. Each warning device 11 will be able to determine in which particular coordinate sector it is located, and then generate the appropriate warning signal based on the received warning message and its own GPS coordinates.

b. Variable Danger Emergency Warning Area Maps

While the map of FIG. 2 has been indicated as a fixed coordinate system, it is also possible to use variable coordinate systems. In this case, no predefined danger emergency warning area map with predetermined regions exists. Instead, received broadcast information signals indicate directly in the messages the boundaries of particular dangerous areas and the danger index associated with those boundaries as determined from the nature of the dangerous situation 52 of FIG. 2.

c. Wide Area Maps

FIG. 3 illustrates the use of a map 56 of the type discussed above in FIG. 2 to cover a large geographic area such as the entire United States. Such a map might be useful, for example, in warning particular areas of the country concerning global weather conditions. Also shown in FIG. 3 is a smaller map 58 covering the state of Alaska. Similarly, FIG. 4 indicates a map 60 of the type discussed above in FIG. 2 for use in a particular city, in this case Washington D.C. Of course smaller areas including sections of cities or neighborhoods may similarly be mapped with defined sectors and areas for receiving specific warning and emergency response dispatch messages for dangerous situations that may exist on a localized basis. An example may be a robbery of a local bank where police may want to notify people in the vicinity of the bank of the danger that exists.

d. Circular Area Maps

As a useful alternative to the rectangular maps of FIGS. 2, 3 and 4, FIG. 5 depicts the use of a circular area map 62 with concentric zones or regions 65, 66, 67 and 68. The dangerous situation 63 has its center at 64 and extends through zones 66, 67 and 68 as illustrated. The respective regions are of radius R1, R2, R3 and R4. FIG. 6 shows a further refinement of FIG. 5 with angular sectors 1 through N. Such sectors permit radial and angular location of warning devices 11 and dangerous situations as broadcast via warning messages herein disclosed.

Warning Device Block Diagram

FIG. 7 depicts a block diagram for a warning device 11 of the type described above. The warning device 11 includes a computer 70, which may be a microprocessor or special controller, together with associated ROM (read only memory) 80 for program and data storage and a RAM (random access memory) 74 used for execution of programs and temporary storage of data received via GPS receiver 82 and warning signal receiver 76. The GPS receiver 82 receives signals from GPS satellites such as GPS satellite 6 of FIG. 1 to enable computation of the location of a warning device 11 by the computer 70. The warning signal receiver 76 receives broadcast danger warning and emergency response dispatch signals from the broadcast communication systems such as pager satellite 4 of FIG. 1. The computer 70 determines its physical location on the earth, and whether or not it is located in an area of danger as indicated by the received broadcast messages. If a dangerous situation is detected, the computer 70 will activate alarm 78 which may be an audible or visible alarm or, perhaps, a vibrating device of the type used in pocket pagers commonly employed today. The computer 70 also may have an output to a video display device 72 for indication of message information including possibly the danger index received

from warning signal receiver **76**. This display may be integral to the warning device **11** and may be viewed by a user after being notified of the dangerous situation via alarm **78**. An alarm magnitude control **84** is also indicated in FIG. **5**, which enables the user to adjust the level of sound or degree of vibration or other alarm parameters according to individual preferences.

Control Center Block Diagram

FIG. **8** illustrates in more detail the structure of the communication and control system equipment **90** contained in the warning command/control center **2** of FIG. **1**. System **90** includes a space signal receiving antenna **92** for receipt of signals from surveillance satellites **8** of FIG. **1**. The input signals from the surveillance satellite are fed through transceiver **94** to preprocessor **96** for connection to communication bus **114** as illustrated in FIG. **8**. The transceiver **94** is capable of both receiving and transmitting signals to and from the surveillance satellite **8** for use in the danger warning and emergency response communication network. The warning command/control center **90** is capable of transmitting control signals, including GPS based command signals, via transceiver **94** and antenna **92** to surveillance satellites **8** to direct surveillance of particular areas, focus on particular fields of view in the areas to be surveyed, select between various surveillance equipment, including video scanning cameras, infrared cameras, and other special camera equipment as may be required to properly survey selected areas of the earth. The preprocessor **96** of FIG. **8** provides an interface between control signals from the communication bus **114** and the transceiver **94** as well as a communication processor function for signals received via transceiver **94** from surveillance satellites **8** of FIG. **1**. The preprocessor **96** is capable of formatting messages to and from the surveillance satellite and controlling communications between the transceiver **94** and the surveillance satellite **8**.

In addition, as illustrated in FIG. **8**, the warning control center **90** includes antenna **98** for transmission and receipt of surveillance aircraft/vehicle/drone or ground based surveillance signals. The antenna **98** is connected via transceiver **100** to preprocessor **102** which in turn is connected to communication bus **114** of the warning control center **90** as illustrated in FIG. **8**. The preprocessor **102** controls communication between the warning command/control center **90** and the various surveillance equipment located in aircraft, vehicles, or pilotless drones or in ground based surveillance as indicated in FIG. **1**. Just as in the case of communication with surveillance satellite **8**, the warning control center **90** may transmit command/control messages, including GPS based command signals, to the various ground based and aircraft surveillance equipment via the preprocessor **102** and transceiver **100**.

The warning control center **90** also includes image processors **104** with associated co-processors **106** to perform analysis of received image signals generated via video scanning from the surveillance satellites, surveillance aircraft or ground based surveillance equipment of FIG. **1**. The image processors **104** and co-processor **106** are especially adapted for high-speed parallel image processing and may include the use of such techniques as neural networks and high speed vector processing computers. The use of neural networks is discussed in more detail below.

The warning control center **90** also includes control processor **116** with memory **118** which receives input signals from the various surveillance equipment discussed above and generates warning control signals for transmission via pager or other broadcast communication media as discussed above. The control processor **116** may be implemented using various control system strategies including, for example, expert system technology and/or fuzzy logic approaches. More particularly the use of fuzzy logic inference rules to generate the necessary danger warning and emergency response control signals is discussed in more detail below.

The danger warning and emergency response messages are transmitted via command processor **112** and transmitter **110** through antenna **108** to the pager satellite **4** of FIG. **1**. In addition, such command control messages may be sent via communication processor **132** of FIG. **6**, which is in-turn connected to communication lines **134** for communication with, for example, auxiliary TV/radio broadcast station **16** of FIG. **1**. As discussed above, this approach using communication processor **132** and the communication lines **134** will enable operation of the disclosed danger warning and emergency response message control system using ordinary broadcast radio and television systems including the use of cable systems.

Database computer **120** with database storage unit **122** contains information characterizing particular regions or areas to be surveyed including information on the vulnerability of particular areas to particular types of dangerous situations including, as well, information on the value of properties that may be contained in such regions. This information is particularly useful in generating danger warning signals and emergency response dispatch signals. For example, select areas may have very high population densities which may be very vulnerable to particular weather or other types of emergency situations. Also, certain physical structures may be vulnerable to certain types of disasters. Highly dense forested areas may be vulnerable to forest fires, and forested areas containing high population densities may be even more vulnerable. As discussed in more detail below, the use of such vulnerability factors characterizing different regions to be surveyed may be used to establish appropriate warning danger index levels and to establish priorities for emergency response dispatch.

The display processor **124** along with display terminals **126** of FIG. **6** are used at the warning command/control center **2** to display the results of the surveillance and analysis of signals received from surveillance equipment to inform operators of dangerous situations in various regions being surveyed. In addition, speech synthesizer **128** and speakers **130** may be used to produce audible warning signals to control center operators and personnel using the warning control center **90** of FIG. **8**.

FIG. **9** indicates the general structure of a broadcast danger index message **140** transmitted from the control center via, for example, pager satellite **4** of FIG. **1**. The message includes message fields as indicated for various areas under surveillance. For each area, the message includes GPS coordinates of the area boundaries **142** along with a calculated danger index **144** for that particular area. Different coordinates and danger indices are transmitted for each of the areas for which a dangerous situation may exist. As discussed above, the warning devices **11** of FIG. **1** compare the calculated GPS location coordinates of individual warning devices with the received GPS boundary coordinates in successive sections of the broadcast danger index message of FIG. **9**. If a particular warning device **11** determines that it is located within the boundaries defined by the GPS coordinates corresponding to a particular area, then the warning device **11** **6** will activate warning signals indicating the degree of danger as **7** communicated via the danger index **144** in the broadcast danger index message **140**.

In the case of the circular warning areas of FIGS. **5** and **6**, the broadcast danger index message **140** of FIG. **9** may indicate only the GPS coordinates of the center of the dangerous situation as illustrated in FIG. **5**. The message will then indicate the radius of successive concentric circles defining the concentric warning areas around and in the vicinity of the dangerous situation. For example, in the situation of FIG. **5** different danger indexes would be indicated in the message for areas within a distance of radius **R1**, those within a distance of radius **R2**, and so forth. In this case, the warning device **11** need only decode the GPS coordinates of the center of the dangerous situation, and by comparing those coordinates with its own coordinates, determine the distance between the warning device **11** and the center of the dangerous occurrence. That distance will define the particular concentric area of FIG. **5** within which the warning device **11** is located, and thus define the appropriate danger index for that warning device.

The extension of the circular warning areas with sector divisions as shown in FIG. **6** permits a further refinement of the circular area of FIG. **5** by defining both the distance from the center of the dangerous situation and the particular angular sector in which the warning device **11** may be located. In this case, the messages of FIG. **9** may define danger indices for different sectors of the concentric rings of FIG. **6** by simply specifying the distance from the center of the dangerous situation and the danger index associated with the particular angular sectors located at that distance.

Danger Detection/surveillance Satellites, Aircraft, Drones

FIG. **10** illustrates a configuration **150** of a danger detection satellite such as surveillance satellite **8** in FIG. **1**. The same configuration would also apply to surveillance aircraft/pilotless-drones **10** such as shown in FIG. **1**. Manned surveillance configurations would also include audio command and response links not shown in FIG. **10**. The configuration of FIG. **10** includes a control processor and signal routing circuit **152** used to control communications and switching between the various elements of the surveillance scanning and communication system. The control processor and signal routing circuit **152** is connected to power supply **154** and to clock circuit **156** from which it derives accurate timing. Radio **158** is used to transmit and receive signals via antenna **160** to the warning/command control center **2** of FIG. **1**. The danger detection satellite configuration **150** includes video scanners **162** operated via control lines **174** from the control processing and signal routing circuit **152**. Video scanning signals are converted from analog to digital form by analog/digital convertors **176** and **178** using conventional and well known techniques.

In addition to the video scanners **162**, the danger detection satellite configuration **150** includes infrared scanners **164** likewise controlled by control circuits **174** from the control processor and signal routing circuitry **152**. In a similar manner to that for the video scanners described above, the infrared scanner signals are converted from analog to digital form via analog-to-digital convertors **180** and **182** as illustrated in FIG. **10**. In addition to the control processor and signal routing circuit **152**, control processor **168** is used to control communications from the surveillance satellite with the ground station via radio **158** and antenna **160**. The control processor also receives control commands from the ground station, decodes those commands, and generates control signals for the video scanners **162** and the infrared scanners **164**. Control memory **166** is used with control processor **168** for storage of program and control information necessary for operation for the overall scanning and surveillance system.

FIG. **10** also illustrates the use of image processors **170** which may be implemented using neural networks or other specialized image processing architectures including high speed vector processors and parallel processing systems. The image processors **170** are connected to image memory **172** wherein information from video and infrared scanners is stored prior to processing by the image processor **170**. Intermediate results from image processors **170** may also be stored in image memory **172** depending upon the image processing and analysis algorithms implemented. The results of the image processing are transmitted under control of control processor **168** to the warning/command control center **2** of FIG. **2**. Entire images may be transmitted or only images that have been analyzed and for which there is concern that a dangerous situation may exist as determined by image processor **170**. Image signals from the video scanners **162** and infrared scanners **164** may also be directly transmitted via radio **158** and antenna **160** to the ground station without the use of image processor **170**. When appropriate, image processor **170** may be able to conserve bandwidth on down link **22** to warning/command control center **2** of FIG. **1**, permitting more comprehensive scanning and transmission only of signals for which it has been determined that a dangerous situation may exist.

Emergency Response/dispatch Services

FIG. **11** illustrates an emergency response/dispatch system and method useful in the present inventions. In FIG. **11**, the warning control center **202** may be integrated with the warning/command control center **2** of FIG. **1**, or, in fact, may be separate and communicate via radio or wireline or wireless links with the warning/command control center **2**. The warning control center **202** is used to dispatch and control emergency response services to assist in alleviating the dangerous situation. Such services might include fire fighting equipment, police forces, military forces, medical emergency units, or any other emergency service personnel and/or equipment. The location of such equipment indicated via vehicles **206** in FIG. **11** is accurately known via GPS satellite **6** using conventional and known techniques. The warning control center **202** communicates with remote control centers **204** which may be dispersed over widely separated geographic areas and used for control and dispatch of emergency services, personnel and equipment located on a regional basis. The remote control centers in-turn transmit dispatch signals and communicate with the emergency response and disaster assistance personnel and equipment **206** as illustrated in FIG. **11**. The remote control centers may also communicate with each other to further facilitate the most efficient dispatching of emergency response of systems.

In addition to operation based on communications to and from the warning/command control center **2** of FIG. **1**, the warning control center or remote control centers of FIG. **11** also will receive the broadcast danger index messages **140** indicated in FIG. **9**. Using this information, each of the remote controls centers will be able to immediately decode broadcast messages indicating dangerous situations within the region for which they have dispatch responsibility. This immediate access to the broadcast danger index messages **140** of FIG. **9** can be of great assistance in facilitating proper dispatch of emergency assistance. Likewise, the emergency equipment **206** of FIG. **11** will receive the broadcast danger index messages of FIG. **9**, and also will have direct decode capability, further facilitating rapid dissemination of infor-

mation relative to dangerous situations and thus insuring the most timely response possible from emergency assistance personnel and equipment.

Neural Computing Networks and Image Processing

Shown in FIG. **12** is one embodiment of a neural computing network having processing elements suitable for performing successive computations on image and other data derived from scanning and surveillance. Such neural computing networks are used to carry out the image processing in the computers **104** of FIG. **8** and **170** of FIG. **10**. The neural network of FIG. **12** includes multiple processing elements **214** and **216** configured in layered structures. The processing elements (PE's) map input signal vectors to the output decision layer, performing such tasks as image recognition and image parameter analysis. Although the layered structure of FIG. **12** is shown as the preferred embodiment, it is noted that any appropriate neural network computer processing configuration can be substituted.

A typical neural network processing element or circuit is shown in FIG. **13**. Input vectors **221** (identified as X1, X2, . . . Xn) are connected via weighing elements **222** (identified as W1, W2 . . . Wn) to a summing node **224**. The output of node **224** is passed through a non-linear processing element **228** to produce an output signal U. Offset or bias inputs can be added to the inputs through a weighing circuit **226** (identified as Wo). The non-linear function **228** is preferably a continuous, differentiable function, such as a sigmoid, which is typically used in neural network processing element nodes.

In accordance with standard expert system and neural network programming techniques, the neural networks used in the danger detection system of the invention are trained to continuously analyze various types of image data to recognize, quantize and characterize such images throughout the surveillance operations. Training the network involves providing known inputs to the network resulting in desired output responses. The weights are automatically adjusted based on error signal measurements until the desired outputs are generated. Various learning algorithms may be applied. Adaptive operation is also possible with on-line adjustment of network weights to meet imaging requirements.

The neural network configuration of the image analysis computers of FIGS. **8** and **10** is preferably implemented in a highly parallel image processing structure, enabling rapid image analysis and recognition necessary for optimizing danger detection and decision making real time message dispatch decisions. Very Large Scale Integrated (VLSI) circuit implementations of the neural processing elements provide a relatively low cost but highly reliable system important to a warning and automatic dispatch system of the type herein disclosed. In particular, loss of any one processing element does not necessarily result in a processing system failure.

The above described programming techniques are well know to those of ordinary skill in the art, as discussed in the various references incorporated by reference above, and accordingly, are not repeated in detail here. Other processing implementations can be substituted. For example, in the alternate embodiment shown in FIG. **14**, the neural computing network is implemented with multiple virtual processing elements **236** coupled to an image processor **232**. Image data is presented to the image processor **232** over date bus **234** and is routed to selected virtual processing elements **236**, which implement the neural network computing functions. The virtual processing elements **236** may comprise pipe-lined processors to increase the overall speed and computational efficiency of the system.

Expert Knowledge Systems and Fuzzy Logic

The herein disclosed danger warning and emergency response dispatch systems and methods are based on the generation of danger indices indicating the degree of danger in various geographical areas. The factors involved in making such computations are many and complex requiring a structured and logical approach in organizing large amounts of data and information, and from that information generating danger indices indicative of actual dangers in different areas based upon multiple inputs from surveillance scanning systems and from database computers. Problems of this type generally benefit from the use of expert system technology with preprogrammed decision rules based upon expert experience reflecting proper response to various situations. Various such expert system approaches are possible and may be used in the danger warning and emergency response dispatch systems and methods herein disclosed. Indeed, it is the intent that the invention herein described not be limited to any particular data analysis and organization methods. However, a particularly attractive method, and one which demonstrates the interrelationship of the various variables and the logical operations necessary to generate the desired danger indices and corresponding control and dispatch messages is that of fuzzy logic. The complexities and range of options in the danger warning system herein described makes fuzzy logic an ideal methodology to optimize the warning and dispatch process by monitoring and analyzing the various sensor outputs according to properly weighted parameters.

The fuzzy logic controllers execute fuzzy logic inference rules from a fuzzy rule base. Input and output variables are defined as members of fuzzy sets with degrees of membership in the respective fuzzy sets determined by specified membership functions. The rule base defines the fuzzy inference system and is based on expert knowledge for system control based on observed values of the control variables. The input data defines the membership functions used in the fuzzy rules. The reasoning mechanism executes the fuzzy inference rules, converting the input data to output control values using the data base membership functions.

A preferred embodiment of the fuzzy logic controller disclosed herein is based on a fuzzy reasoning system using input variables corresponding to at least distance from the danger, area vulnerability, and the relative velocity with which the danger is approaching the area. The fuzzy logic inference system generates output signals that indicate danger indices for each of the areas of concern. The preferred embodiment of the fuzzy logic controller is implemented using trapezoidal fuzzy membership functions as shown in FIGS. **15A** through **15D**. Other membership functions (MF's) are possible including: (1) Triangular MF's, (2) Gaussian MF's, (3) Generalized Bell MF's, and (4) Sigmoidal MF's, and can easily be substituted for the trapezoidal fuzzy membership functions.

The rule base for the danger warning and emergency response system and method disclosed herein is formulated with "IF . . . THEN . . ." structures representing the linguistic expression of the logical elements involved in the fuzzy logic rule base. As shown in FIG. **15**, the triangular membership functions include overlapping membership ranges for the following variable rangers:

DISTANCE:	VERY CLOSE, CLOSE, MODERATE, FAR, VERY FAR
VULNERABILITY:	VERY LOW, LOW, NORMAL HIGH, VERY HIGH
RELATIVE VELOCITY:	LOW, MODERATE, HIGH
DANGER INDEX:	VERY LOW, LOW, MEDIUM, HIGH, VERY HIGH

To better understand the fuzzy logic compositional rules applied to the fuzzy danger warning and emergency response system and method herein disclosed, consider first just the Distance variable shown in FIG. 15A. The fuzzy set corresponding to "Very Close Distances" {DVC} is the set of all distances D between zero and the upper distance DVCu defined for very close distances. Similarly, the fuzzy set corresponding to close distances {DC} is the set of all distances between the lowest defined close distance DCl and the upper close distance DCu. Because of the "fuzzy" definitions of "very close" and "close", it will be true that DCl<DVCu, and the fuzzy sets will overlap. Similarly, overlap occurs between the other defined distance ranges.

The nature of the overlapping membership functions for several of the variables involved in the disclosed danger warning and emergency response system and method is illustrated in FIGS. 15A through 15D. Similar relationships would exist for other variables not shown.

In the fuzzy logic implementation, the three input variables (distance, vulnerability, and relative velocity) are used to compute the danger index with the corresponding membership functions indicated in FIG. 15. Example danger index fuzzy logic inference rules are shown in FIG. 16.

In the example rule set shown in FIG. 16, twenty-five fuzzy logic inference rules are indicated for each of the three values of relative velocity: Low, Moderate, and High. A total of 75 rules are indicated. For each of the values of relative velocity, various combinations of vulnerability and distance are indicated. In each of the three matrices, the distance variables are indicated in the five columns while the vulnerability indices are indicated in the rows of the matrices. For example, reading from FIG. 16:

IF Relative Velocity=Low, and Distance=Close and Vulnerability=Low, THEN Danger Index=Medium.

IF Relative Velocity=Moderate, and Distance=Very Close and Vulnerability=High, THEN Danger Index 32 Very High.

IF Relative Velocity=High, and Distance=Far and Vulnerability Very High, THEN Danger Index=High.

It should be understood that different rules would exist if different parameters and data were considered. The examples given here are only meant to be illustrative of the possibility of organizing the information necessary to generate the danger index and dispatch control messages using fuzzy logic principles.

Because of the overlapping nature of the input variables as indicated in the membership functions of FIGS. 15A, 15B, 15C and for the danger index as indicated in FIG. 15D, multiples of the fuzzy logic inference rules of FIG. 16 may be "fired" for given discrete values of the input variables. The fuzzy logic inference rules of FIG. 15 are structured using the input value for each of the input variables combined with logical "AND" operators. Standard fuzzy logic methods, are used to derive the correct value of the output danger index.

An example calculation using these input variables is illustrated in FIG. 17. Using fuzzy logic principles, the danger index for each combination of input variables is calculated as corresponding to the minimum membership for each of those variables. As shown in row 1 of FIG. 17, for the indicated values of relative velocity, vulnerability and distance, the membership for distance is the minimum of the three which would be the corresponding membership for the very high danger index. Similarly, in the second row of FIG. 17 the minimum membership corresponds to the vulnerability factor, which determines the membership in the high range for the danger index. This figure illustrates just two of the multiple fuzzy logic inference rules fired by the indicated variable fuzzy membership grade. The discrete value for the danger index can be calculated using the centroid method as indicated in FIG. 17, or other appropriate defuzzification algorithms.

FIG. 18 indicates an area danger index matrix computed with the above described methods. An index Dij is calculated for each area being surveyed by the surveillance mechanisms herein above disclosed. It is these danger indices that are transmitted via the broadcast danger index messages of FIG. 9. In the case of the rectangular grid of FIG. 2, a danger index is computed for each of the indicated rectangular sections using the fuzzy logic inference principles described above. In the case of circular warning areas with sector divisions as shown in FIG. 6, danger indices would be computed for each of the indicated areas such as area A 32 indicated in FIG. 6.

An area value matrix is indicated in FIG. 19 with the values Vij representing values of respective regions or areas being scanned. Once again, in the case of a rectangular array, a value index would be used for each of the rectangular subareas. Similarly, in the case of the circular areas with sector divisions as shown in FIG. 6, a value would be determined for each of the circular subareas. The values in the matrix 252 may reflect the presence of high population densities, very valuable properties, or valuable natural resources. Separate value matrices may be obtained for valuable objects, property or persons in particular areas to be surveyed. The particular numerical values in the value matrix may be stored, for example, in the database storage 122 of FIG. 8.

Using a combination of the values in the area danger index matrix 250 of FIG. 18 and the value matrix 252 of FIG. 19, an area priority matrix 254 may be computed as shown in FIG. 20. This matrix may be of assistance in dispatching emergency assistance personnel and resources in a manner that depends on both the danger and the value of the personnel or objects present in each of the areas. For example, one area may have a high danger index, but with no population and/or very little valuable assets contained therein. In such an instance, it may be wiser to dispatch emergency assistance to other areas that may have a lower danger index but have a higher priority based on the value of the contents of the area. With this type of calculation, danger indices and priority indices may be transmitted via the broadcast emergency message transmitting system indicating the degree of danger to the persons or objects located in each individual area, and also prioritizing those areas which should first receive emergency assistance based on the value of the contents of particular areas.

FIG. 21 is a generalized, overall flow diagram for the danger warning and emergency dispatch message systems and methods herein disclosed. As indicated in FIG. 21, input data may come from satellite/aircraft/pilotless drones or from ground based surveillance systems as indicated in FIG. 1. Continual monitoring occurs for dangerous situations in block 264. If danger is detected, danger test 270 passes

control to the warning command control center by transmitting appropriate data as indicated in control block **272** of FIG. **21**. The received data is analyzed in block **274** using the techniques and methods disclosed herein above. Information is retrieved from the database indicating the vulnerability of particular areas and the value of persons and/or other objects that may be present in each individual area in block **276**. Based on successively received indications of danger, the relative velocity of the dangerous situation in any given direction is calculated in block **278**. Using the above described information, the danger index matrix is calculated in block **280** of FIG. **21**. If appropriate, the priority matrix described above is calculated in block **282** based on the value of personnel and/or assets in each individual area. Warning and dispatch messages are transmitted in block **284** via the broadcast network. Emergency assistance is dispatched in block **286** of FIG. **21**.

A further embodiment of the present invention includes an earth scanning system and method employing a plurality of earth scanning platforms, including a plurality of earth satellites **8** and a plurality of pilotless drone aircraft **10**, each of which platforms supports one or more electronic (e.g. television) cameras. Two-way communications **22***a* between computing systems in the satellites **8** and computing systems in the drones **10** of the system are effected to maximize system detection and efficiency. The method also employs artificial intelligence including neural networks and fuzzy logic ware, including software and electronics hardware, to control data transfer, scanning by both the satellite **8** and drone mounted scanning (television) systems **10**, and control of the flight path(s) of the scanning pilotless aircraft or drones **10**.

A still further embodiment of the present invention includes a planet earth surveillance system and method for scanning select portions of the earth and computer analyzing the surveillance or scanning signals to detect variables in planet earth, wherein a plurality of moving aerial platforms including pilotless drones **10** and earth satellites **8** are employed, improvements are provided in communicating **22***a* between and control of the surveillance platforms **8**, **10** in their movements and/or their scanning of the earth. In one form, a plurality of geo-synchronized earth satellites **8** can select a portion of the earth's surface which selected portion is also scanned by a plurality of pilotless drones **10** wherein one or more of such drones is controlled by signals from either the satellites **8**,**22***a* and/or from a master computer on the ground **2**, **24** which includes a computerized image analysis system for the satellite and drone scanning system. Satellite scanning operations are also controlled by such computer at least partly as a result of the results of computerized analysis of the image signals generated by the satellites and drone aircraft earth scanning system.

The inventions set forth above are subject to many modifications and changes without departing from the spirit, scope or essential characteristics thereof. Thus the embodiments explained above should be considered in all respect as being illustrative rather than restrictive of the scope of the inventions as defined in the appended claims. For example, the scanning and surveillance operations may be carried out using a wide variety of sensing equipments. Similarly the various computing operations described herein may very depending upon the particular computer structures and algorithmic approaches selected.

What is claimed is:

1. A method of providing an automated, wide area, danger warning and emergency response comprising the acts of:

(a) transmitting information signals from a detection location via radio transmission signals to a control center for analysis,

(b) analyzing the received information signals in the control center in computer systems employing expert system technology,

(c) determining in the control center the existence of danger at the detection location based on analysis of the received information signals,

(d) generating in the control center a danger warning,

(e) generating in the control center an emergency response including a danger index indicating a degree of danger,

(f) broadcasting the danger warning and emergency response from the control center to a plurality of remotely located warning devices each of which has a GPS receiver and the ability to calculate its own location in GPS coordinates,

(g) receiving via the broadcast signals the danger warning and emergency response in the remotely located warning devices, and comparing in each remotely located warning device the coordinates of the dangerous situation with its own GPS coordinates for determining the proximity of the remote warning device to the detection location, and

(h) automatically issuing from the control center a signal corresponding to the extent to which the remotely located warning device is in danger.

* * * * *

US006594345B1

(12) **United States Patent**
Vinson

(10) **Patent No.: US 6,594,345 B1**
(45) **Date of Patent: Jul. 15, 2003**

(54) **TARGETED DISASTER WARNING SYSTEM AND APPARATUS**

(75) Inventor: **R. Keith Vinson**, Vestavia Hills, AL (US)

(73) Assignee: **BellSouth Intellectual Property Corporation**, Wilmington, DE (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/409,687**

(22) Filed: **Sep. 30, 1999**

(51) **Int. Cl.**[7] **H04M 11/04**; H04M 3/42
(52) **U.S. Cl.** **379/48**; 379/207.15; 379/221.08
(58) **Field of Search** 379/37, 40–42, 379/48–51, 88.21, 93.17, 93.23, 142.01, 142.04–142.06, 142.1, 142.17, 207.15–207.16, 221.08–221.14, 229–235, 201.04; 340/539, 601, 988, 990, 995; 445/414–415

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,908,819	A *	3/1990	Casady et al.	370/204
5,701,301	A	12/1997	Weisser, Jr.	379/127.03
5,774,533	A	6/1998	Patel	370/428
6,002,748	A *	12/1999	Leichner	340/601
6,028,921	A *	2/2000	Malik et al.	379/201.04
6,084,510	A *	7/2000	Lemelson et al.	340/539
6,201,856	B1 *	3/2001	Orwick et al.	379/40

OTHER PUBLICATIONS

BellcoreTechnical Reference NWT-001188, Issue 1, "CLASSSM Feature: Calling Name Delivery Generic Requirements," FSD 01-02-1070 (Dec. 1991).
Bellcore Technical Reference NWT-000031, Issue 4, "CLASS Feature: Calling Number Delivery," FSD 01-02-1051 (Dec. 1992).

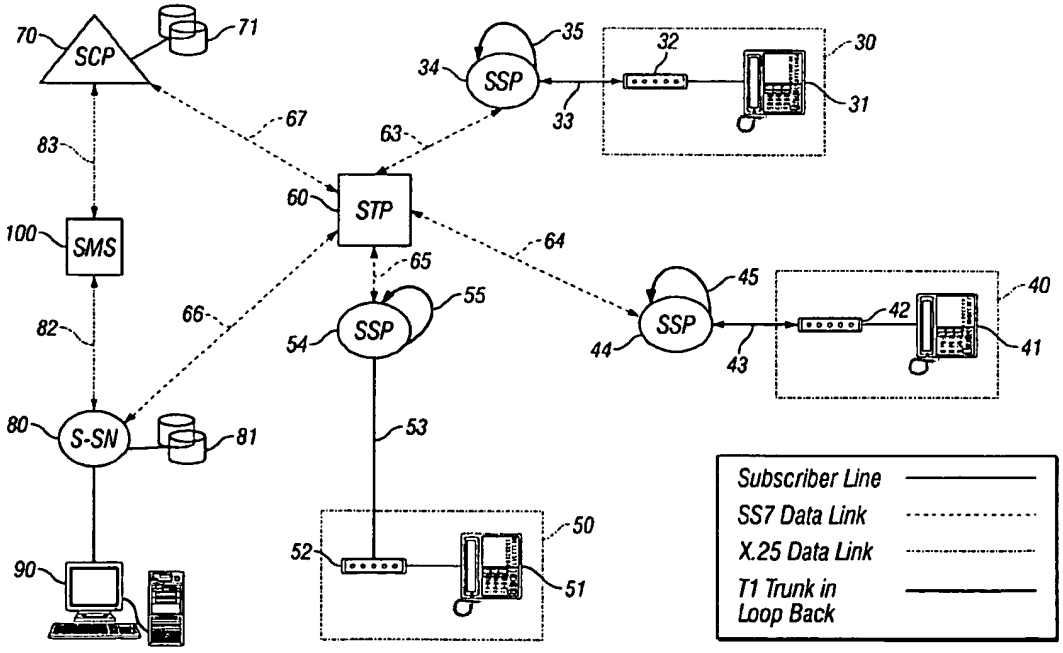
* cited by examiner

Primary Examiner—George Eng
(74) *Attorney, Agent, or Firm*—Shaw Pittman LLP

(57) **ABSTRACT**

A system and method for providing early warning notifications to telephone subscribers having calling number delivery service. The system uses an advanced intelligent network to initiate several calls in rapid succession to all calling number delivery subscribers located within a predetermined geographic area. A code identifying the disaster warning message is transmitted to the subscribers' calling number delivery systems in place of an actual calling line identification. Subscribers having calling name delivery service receive the disaster code and a text message briefly describing the disaster warning.

50 Claims, 3 Drawing Sheets



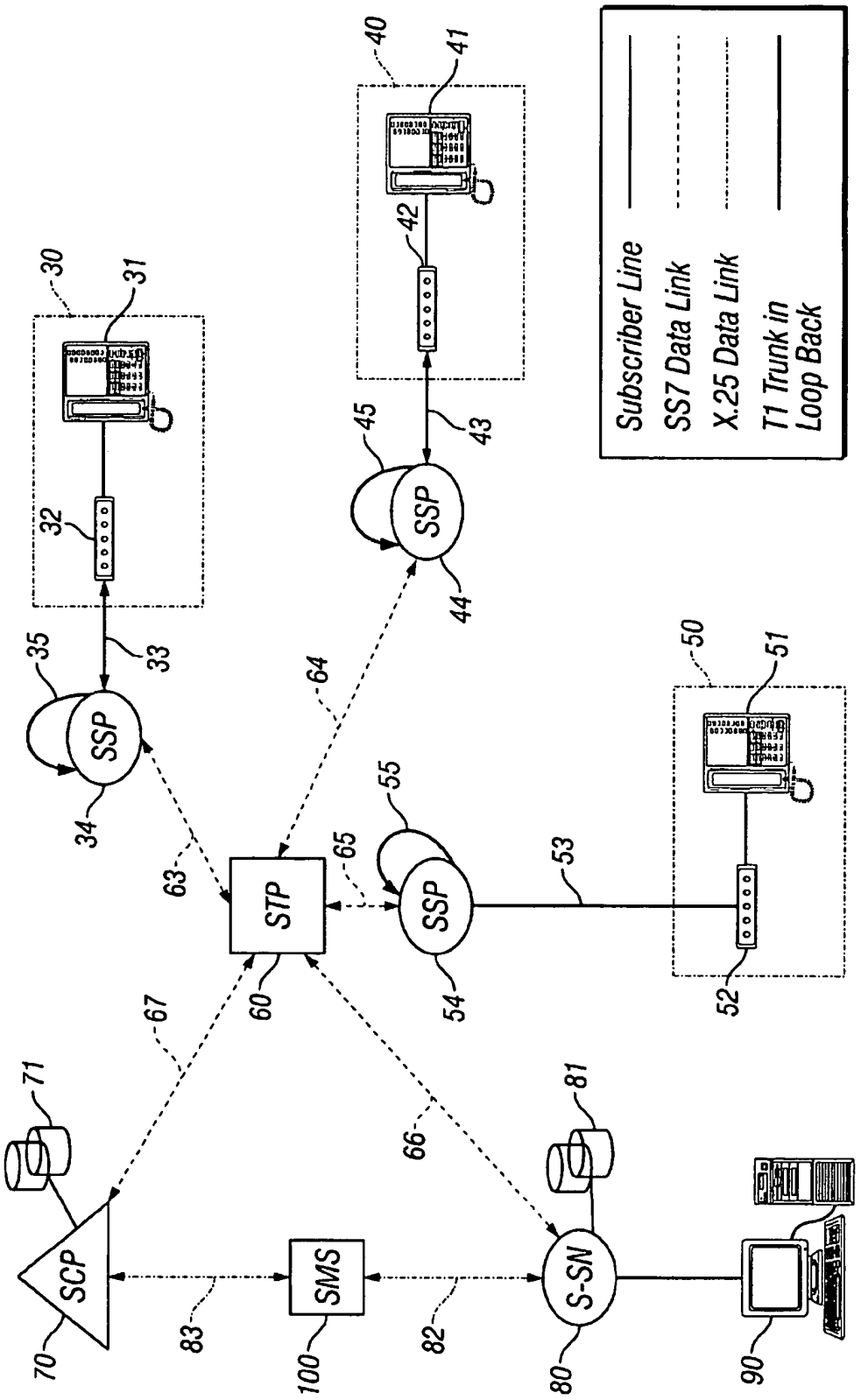

Subscriber Line
SS7 Data Link
X.25 Data Link
T1 Trunk in Loop Back
SSP
SSP
SSP
STP
SCP
SMS
S-SN
30
31
32
33
34
35
40
41
42
43
44
45
50
51
52
53
54
55
60
63
64
65
66
67
70
71
80
81
82
83
90
100

FIG. 1

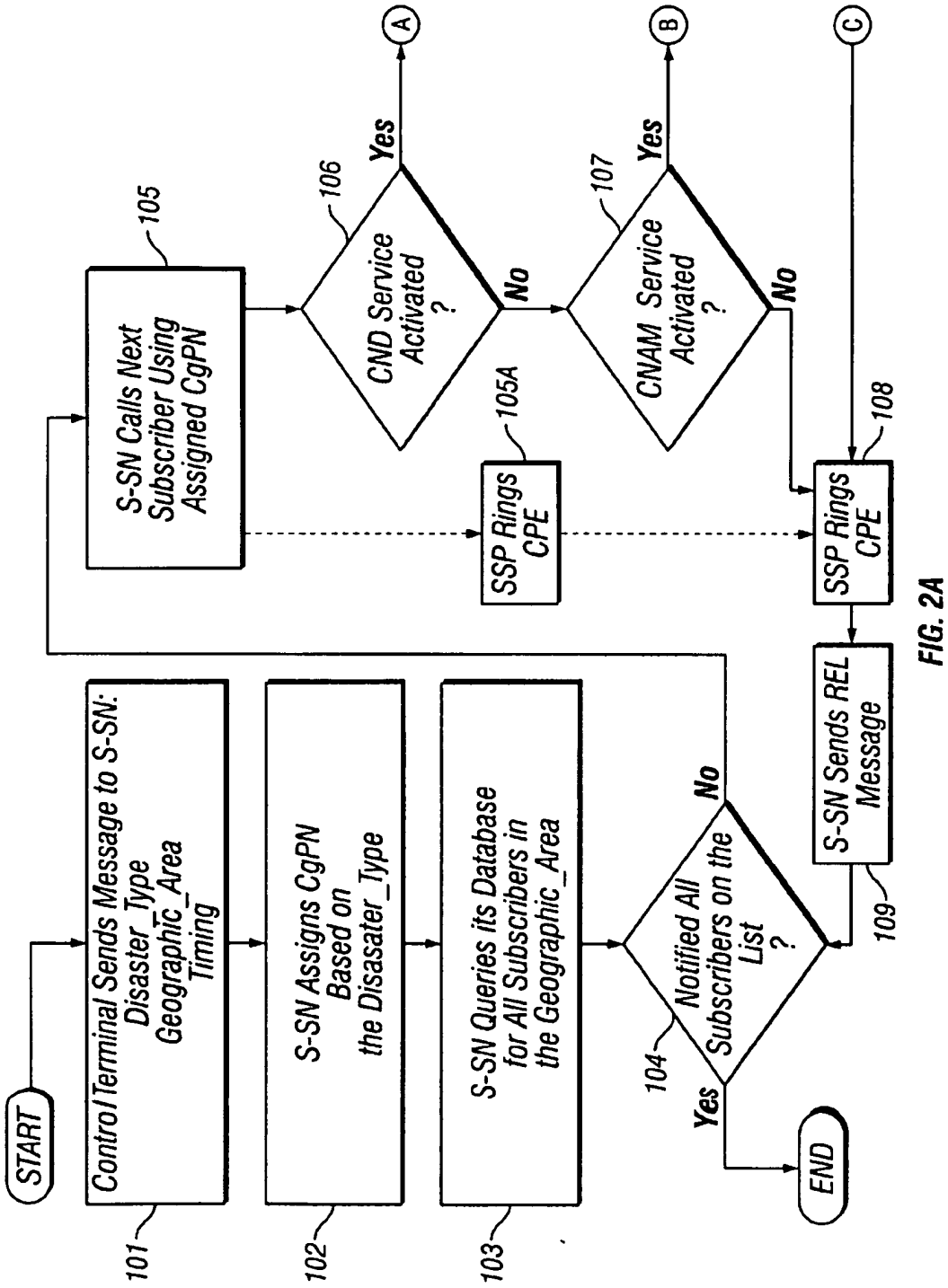

START
Control Terminal Sends Message to S-SN: Disaster_Type Geographic_Area Timing
101
S-SN Assigns CgPN Based on the Disasater_Type
102
S-SN Queries its Database for All Subscribers in the Geographic_Area
103
Notified All Subscribers on the List ?
104
No
Yes
END
S-SN Sends REL Message
109
SSP Rings CPE
108
S-SN Calls Next Subscriber Using Assigned CgPN
105
SSP Rings CPE
105A
CND Service Activated ?
106
Yes
No
A
CNAM Service Activated ?
107
Yes
No
B
C

FIG. 2A

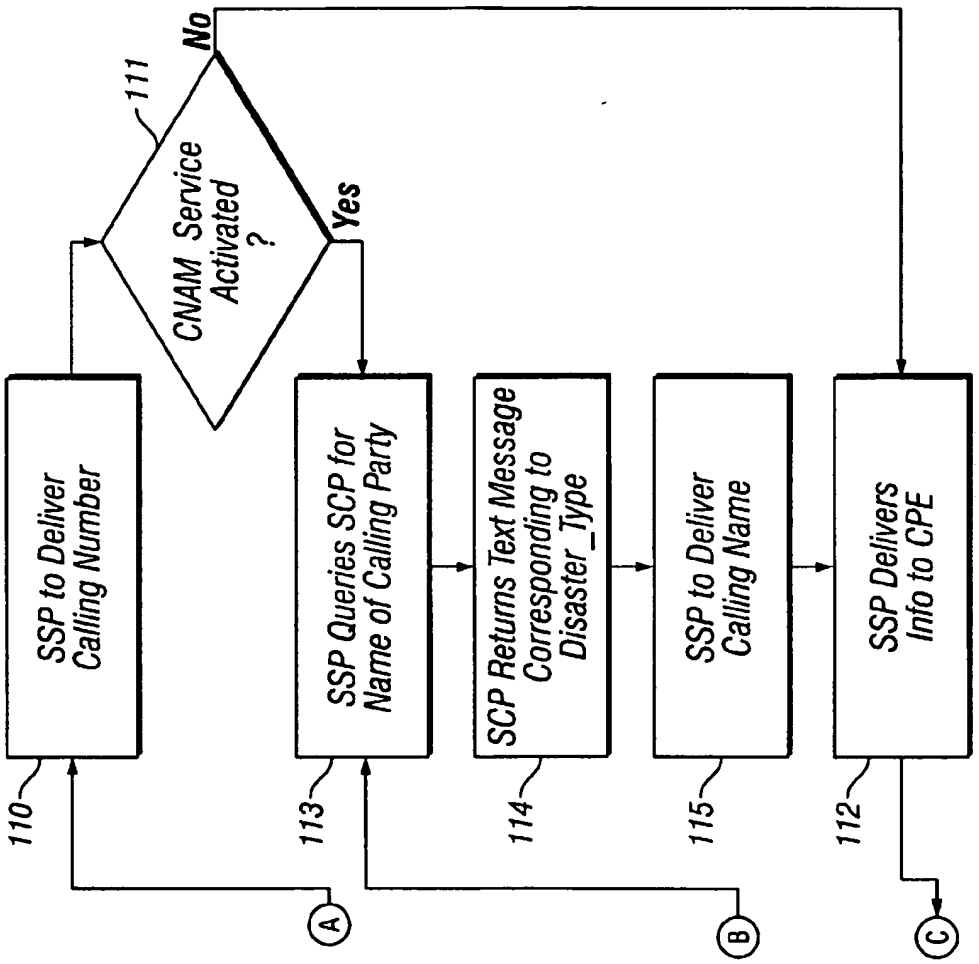

No
111
CNAM Service Activated ?
Yes
SSP to Deliver Calling Number
SSP Queries SCP for Name of Calling Party
SCP Returns Text Message Corresponding to Disaster_Type
SSP to Deliver Calling Name
SSP Delivers Info to CPE
110
113
114
115
112
A
B
C

FIG. 2B

TARGETED DISASTER WARNING SYSTEM AND APPARATUS

BACKGROUND

1. Field of the Invention

The present invention relates generally to providing targeted disaster warnings to telephone subscribers in predetermined geographic areas.

2. Background of the Invention

Early warnings of natural (e.g., tornadoes) or man-made (e.g., leaks of toxic gases) disasters can save lives. However, any warning, no matter how timely, must be actually received by the people in danger, and must be heeded by the recipient if there is to be any benefit. Conventional systems for issuing disaster warnings may be directed to very large populations, for example, by radio or television, or may be directed to very small populations, for example, by people going house-to-house to notify the occupants. More recently, "weather radio" is being implemented to allow more localized warnings based on the listener's specific location.

However, all of these early warning systems have inherent disadvantages that reduce their effectiveness. For example, in the case of radio and television broadcasts, the television or radio sets must be turned on and monitored for the warning to be received. Moreover, it is not uncommon for the power systems in disaster zones to be out of operation, further limiting the likelihood that the target audience will receive the warnings. Finally, because television is designed to reach a maximum audience in a geographic region, it cannot currently be used to specifically target only those in the greatest danger. Thus, the warnings are sent to far more people than actually need to be warned. If people are often interrupted by alarms that do not apply to them, then they are less likely to heed subsequent warnings.

The "weather radio" system, when fully implemented, may overcome some of these limitations by issuing a radio signal to specially purchased radio receivers. The signal will cause the radio set to turn itself on and broadcast the warning to all listeners. However, even this solution has some disadvantages. First, the system is not in widespread use because it requires the purchase of a special radio receiver. Second, while weather radio can be directed toward a more specific geographic area than other broadcasting means, it cannot target very small regions, such as people located on a certain street. More people will receive the warning than are actually in danger, resulting in false alarms for many people. Thus, with weather radio systems, the result could be even more dangerous, as people who have been inconvenienced by false alarms may disable the feature or merely ignore further weather radio warnings.

When house-to-house personal warnings are issued, or neighborhood-wide announcements made via loud speakers, the deficiency is not in reaching the correct audience, but reaching them in time to provide sufficient early warning. Even if the target area is very small, if the danger stems from a rapidly moving force, such as a tornado, personal notification cannot provide the necessary early warning.

SUMMARY OF THE INVENTION

The present invention utilizes an Advanced Intelligent Network ("AIN") to provide early disaster warnings to recipients in specifically targeted geographic areas. AIN systems are described in U.S. Pat. Nos. 5,701,301 and 5,774,533, which are incorporated herein by reference in their entirety. The invention uses existing calling number delivery ("CND") and calling name delivery ("CNAM") systems to provide early disaster warnings to subscribers within the targeted areas. The invention includes a specialized service node ("S-SN") shown in the FIG. 1. The S-SN is connected to a computer control terminal that defines the geographic area to which the targeted warning message must be sent. The S-SN is a service node, as is currently well known in the art, with added capabilities such as multiple communications links to multiple service switching points ("SSPs" or "switches"). Additionally, the S-SN is programmed to partially emulate an SSP by issuing call setup and release messages to other SSPs using the Common Channel Signaling System 7 ("SS7") network. However, in a preferred embodiment, the S-SN has no actual voice trunks installed, i.e., does not emulate the full capabilities of an SSP. In a preferred embodiment, the computer control terminal is operated by a national or regional authority such as the National Weather Service ("NWS").

In the present invention, an operator (or software) on the computer control terminal transmits a warning message to the S-SN along with the geographic regions to be warned. In a preferred-embodiment, the computer control terminal is equipped with a graphical user interface allowing an operator to select the warning area by highlighting different portions of a map. The maps used in this preferred embodiment have a range of scales, down to the street-level, enabling highly specific targeting of the warning area.

In a preferred embodiment, the S-SN maintains a database of all customers having subscriptions to CND service, CNAM service or both. The database includes the subscribers' telephone number and geographic location (e.g., a street address). In an alternate embodiment, the database stores information only for those customers specifically subscribing to the Disaster Warning service. The S-SN identifies the subscribers within the specific geographic region to be warned and initiates a series of telephone calls in rapid succession to all of the identified subscribers. The S-SN issues call setup messages in which the Calling Party Number ("CgPN") field is set to a numeric code corresponding to the type of emergency. In this way, when a subscriber's customer premises equipment ("CPE") displays the calling party's number, it displays the special warning code. Each type of emergency or action required is assigned a unique numeric code. When the numeric code is displayed as the calling number, the subscriber is alerted to the disaster.

Subscribers having CNAM service receive a text message displaying a brief warning message. In a preferred embodiment, a text message and the numeric code for each Disaster_Type are stored in an existing name database used to support CNAM services. Such name databases are generally stored on a Service Control Point ("SCP"). In response to a CNAM query, the SCP returns the disaster text message for display on the subscriber's CPE. The text display provides all the information necessary to alert the subscriber of the impending danger. In an alternate embodiment, the disaster text message is contained within the call setup message issued by the S-SN. In this embodiment, a database query is not necessary.

The S-SN follows each call setup message with a call release message. However, to allow sufficient time for the delivery of the calling number and/or calling name, the call release message is sent only after a pre-determined waiting period elapses. The pre-determined waiting period is at least as long as the name retrieval timer set within the switch, i.e., the timeout period for CND or CNAM services. In a preferred embodiment, the pre-determined waiting period is at least six seconds.

It is an object of the present invention to provide a disaster warning system that overcomes the above-cited problems. More specifically, it is an object of the present invention to provide a disaster warning system that is targeted to reach only people in imminent danger.

Another object of the present invention is to provide a disaster warning system that minimizes the incidence of false alarms.

Another object of the present invention is to provide a disaster warning system that is compatible with existing telecommunications equipment.

Another object of this invention is to provide a disaster warning system using telecommunications equipment that is already prevalent in people's homes and/or workplaces.

Another object of the present invention is to provide a disaster warning system capable of reaching people in a targeted area almost simultaneously with the determination to issue the warning.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram showing the key components of an Advanced Intelligent Network used in an embodiment of the present invention.

FIG. **2** is a flowchart showing the steps performed in an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention utilizes an Advanced Intelligent Network ("AIN") to provide the targeted disaster warning of the present invention. More specifically, the present invention uses CND and CNAM systems to provide targeted disaster warnings to subscribers within specific geographic areas. The implementation and operation of CND systems are described in Bellcore Specification TR-NWT-000031, Calling Number Delivery, which is incorporated herein by reference in its entirety. CNAM systems are described in Bellcore Specification TR-NWT-001188, Calling Name Delivery Generic Requirements, which is incorporated herein by reference in its entirety.

FIG. **1** is a schematic diagram of the present invention showing a Specialized Service Node ("S-SN") **80**. S-SN **80** has all of the features of a regular Service Node ("SN"), but is also equipped with Common Channel Signaling System 7 ("SS7") data links, and has the capability of issuing telephone call setup and release messages to several Service Switching Points (referred to herein as either "SSP" or "switch") simultaneously. Such call setup and release messages are transmitted over SS7 data link **66** as Integrated Services Digital Network User Part ("ISUP") messages. The capability to issue ISUP messages allows S-SN **80** to emulate some functions of a switch. However, in a preferred embodiment, S-SN **80** has no voice trunks, so although it issues ISUP messages, no actual voice circuits are allocated between S-SN **80** and a switch. S-SN **80** transmits ISUP messages using SS7 link **66** to Signaling Transfer Point ("STP") **60**. STP **60** has SS7 links **63**, **64**, **65** and **67** to Service Switching Point ("SSP") **34**, SSP **44**, SSP **54** and Service Control Point ("SCP") **70**, respectively. Additionally, in a preferred embodiment, S-SN **80** receives database updates from Services Management System ("SMS") **100** using data link **82**. In a preferred embodiment data link **82** uses a high-speed data communications protocol, such as Asynchronous Transfer Mode ("ATM"), TCP/IP or X.25, each of which are well known in the art.

S-SN **80** is connected to computer control terminal **90** which is used to define the geographic area in which to send the targeted warning message. In a preferred embodiment, computer control terminal **90** is operated by a national or regional authority such as the National Weather Service or a state-operated disaster prevention/alerting body.

FIG. **2** is a flow chart exemplifying the steps performed in an embodiment of the present invention. The flow chart is described with reference to subscribers **30**, **40** and **50** in FIG. **1**. Subscriber **30** has telephone **31**, CPE **32**, and analog telephone line **33** connected to SSP **34**. Subscriber **40** has telephone **41**, CPE **42**, and analog telephone line **43** connected to SSP **44**. Similarly, subscriber **50** has telephone **51**, CPE **52**, and analog telephone line **53** connected to SSP **54**. Lines **33**, **43** and **53** have telephone numbers 333-333-1000, 444-444-1000 and 555-555-1000, respectively. In this example, subscribers **30**, **40** and **50** live on Street A. Subscriber **30** has CND service, subscriber **40** has CNAM service, and subscriber **50** and both CND and CNAM services. It should be noted that while it is possible for a subscriber to subscribe only to CNAM service, few subscribers would get CNAM without CND.

In the first step, an operator (or software) on computer control terminal **90** transmits a warning message to S-SN **80** (step **101**). In one embodiment, the warning message includes information such as the Disaster_Type and the Geographic_Area. In a preferred embodiment, the message includes additional information such as a Timing parameter, described below.

Each Disaster_Type is assigned a unique numeric code, so the recipient can decipher the warning message. The numeric code is used in the Calling Party Number ("CgPN") field when the warning calls are setup (step **102**). Thus, under current AIN standards, the numeric code is limited to 15 digits. In one embodiment, the Disaster_Type received from control terminal **90** is the unique numeric code. For example, the Disaster_Type could be "911-222-3333" to indicate a category **3** tornado. In an alternate embodiment, S-SN **80** looks up the numeric code in database **81** according to the Disaster_Type. In the present example if the NWS sends a warning message with a Disaster_Type of "category **3** tornado," S-SN **80** consults database **81** to determine that the assigned numeric code is 911-222-3333. Thus, in step **102**, S-SN **80** assigns 911-222-3333 to the CgPN in the call setup messages.

The Geographic_Area identifies the region to which the targeted warning a message will be sent. In a preferred embodiment, a graphical user interface on computer control terminal **90** provides the capability-for selecting the Geographic_Area directly from a mapping system. The maps used in this preferred embodiment provide a high level of granularity enabling highly specific targeting of the area to be warned. Using this system, the operator is able to zoom down to the street-level to select the houses to be notified on a particular street.

The Timing parameter is used to control congestion on the system. In a preferred embodiment, the Timing indicates the order in which to notify subscribers, such as to notify subscribers from Northeast to Southwest within the Geographic_Area selected. In this embodiment, if the Timing is not provided by control terminal **90**, all customers in the Geographic_Area have the same priority.

In a preferred embodiment, the Disaster Warning service is offered as a complimentary service to customers subscribing to CND service or CNAM service. In this embodiment, database **81** on S-SN **80** stores the telephone number and

address for all customers having subscriptions to CND service, CNAM service or both. In an alternate embodiment, the Disaster Service is offered on a subscription basis. In this embodiment, the database stores information only for those customers also subscribing to the Disaster Warning service. The data stored in database **81** is provided by and updated by SMS **100**, which also provides data to SCP **70** for use in database **71**. Data paths **82** and **83** from SMS **100** to S-SN **80**, and from SMS **100** to SCP **70**, respectively, use any suitable digital communications protocol, for example, ATM, TCP/IP or X.25.

In step **103**, S-SN **80** queries database **81** to identify the subscribers within the specific geographic region to be warned. In this example, the NWS warning message indicated the Geographic_Area to be "all houses on Street A." Thus, in step **103**, S-SN **80** compiles a list of all subscribers on Street A, including subscribers **30**, **40** and **50**.

In an iterative manner, S-SN **80** steps through the list of subscribers obtained in step **103** and generates call setup messages for each. In step **104**, S-SN **80** checks to see if all subscribers on the list have been called. If there are any subscribers that have not been called, S-SN **80** moves on to step **105**; otherwise, the disaster warning system has completed its task.

In step **105**, S-SN **80** issues ISUP messages to setup calls to each subscriber. The ISUP messages are Initial Address Messages ("IAMs") which are sent to each subscriber's SSP. The IAM contains the assigned numeric code for the given disaster type in the CgPN field, and the subscriber's telephone number in the Called Party Number ("CdPN") field. For example, an IAM is sent to SSP **34** for subscriber **30**, another IAM is sent to SSP **44** for subscriber **40**, and a third IAM is sent to SSP **54** for subscriber **50**. The first IAM has 911-222-3333 as the CgPN and 333-333-1000 as the CdPN. The second IAM has 911-222-3333 as the CgPN and 444-444-1000 as the CdPN. Finally, the third IAM has 911-222-3333 as the CgPN and 555-555-1000 as the CdPN.

Because the S-SN does not need to send any voice traffic to the subscriber, there is no need to allocate actual voice circuits between the S-SN and the subscriber. However, under the current telephone switching architecture, an SSP will not attempt call termination unless a voice circuit is established between a CgPN and a CdPN. Thus, in a preferred embodiment of the present invention, the SSPs are "tricked" by using special voice circuits **35**, **45** and **55** in a loop-back configuration, as shown in FIG. **1**. When an SSP receives the call setup message from S-SN **80**, the SSP will process the call as if an actual voice circuit were allocated. In a preferred embodiment, loop-back voice circuits **35**, **45** and **55** are created by configuring at least one trunk interface card to loop-back to itself. Suitable trunk interface cards are available from several vendors, e.g., Lucent, Nortel and Siemens. Additionally, voice path verification must be turned off for that trunk group so that the SSP will not check to see if the circuit is valid. S-SN **80** is capable of sending these call setup messages to several SSPs at once because it has an SS7 connection to STP **60**.

Although the subscribers listed in database **81** are all subscribers to CND, CNAM or both, the subscriber may have temporarily deactivated the services. Thus, when the subscriber's SSP receives the IAM, it detects whether or not the called line is activated for CND service, CNAM service or both (steps **106**, **107** and **111**). As shown in FIG. **2**, step **105A** is usually performed concurrently with steps **106**–**108** to minimize delays in call processing. In step **105A**, the SSP initiates power ringing on the subscriber's line. The remaining steps (**106**–**115**) in the flow chart are described in the four examples below.

EXAMPLE I

Subscriber Has Neither CND nor CNAM Activated

In this example, although subscriber **30** normally subscribes to CND service, it has been deactivated. Thus, for subscriber **30**, SSP **34** will detect that neither CND nor CNAM service is currently activated for line **33** (steps **106** and **107**). In this case, SSP **34**, moves on to step **108**, and continues ringing the line. After waiting a pre-determined period, S-SN **80** informs the SSP that the calling party has hung up (step **109**). In a preferred embodiment, S-SN **80** sends a call release (REL) message to the SSP. The waiting period should be long enough to ensure that any data to be transmitted to the subscriber's CPE has been sent. Since CND and CNAM delivery normally takes places between the first and second ring cycle, the waiting period should allow for two ringing cycles to complete. In a preferred embodiment, the pre-determined waiting period is at least six seconds. After sending the call release message, S-SN **80** returns to step **104** and determines whether or not another subscriber is to be notified, as described above.

EXAMPLE II

Subscriber Has CND Only

In this example, subscriber **30** has CND and has not deactivated the service. Thus, in step **106** SSP **34** detects that CND is activated on line **33**, and as a result, prepares to deliver the calling number to CPE **32** (step **110**). In step **111**, SSP **34** detects whether or not line **33** also has CNAM activated. In this example, line **33** does not have CNAM activated, so SSP **34** moves on to step **112**. In step **112**, SSP **34** delivers the information to CPE **32**. That is, SSP **34** uses frequency-shift keying ("FSK") tone modulation to transmit the CgPN for display on CPE **32**. In this case, the disaster warning code of "911-222-3333" will be transmitted to CPE **32**, along with the date and time. When subscriber **30** sees this displayed on CPE **32**, he or she will be informed of the disaster alert.

After delivering the disaster warning code in step **112**, SSP **34** moves on to step **108**. As described above, in step **108**, SSP **34** continues ringing line **33** until it receives the call release message from S-SN **80** in step **109**. S-SN **80** then moves on to the next subscriber to be notified in steps **104** and **105**.

EXAMPLE III

Subscriber Has CNAM Only

In this example, subscriber **40** has CNAM service but does not have CND service. Again, this is an unusual situation, but could occur under current AIN standards. In step **106** SSP **44** detects that CND is not activated on line **43**, and as a result, moves on to step **107** where SSP **44** detects that CNAM is activated on line **43**. In this case, SSP **44** moves on to step **113**. In step **113**, SSP **44** queries SCP **70** for the calling party name using SS7 Transaction Capabilities Application Part ("TCAP") messaging. SCP **70** looks up the CgPN in name database **71** and returns the corresponding name. In this example, when SSP **44** looks up the calling party number, "911-222-3333" in name database **71**, the calling party's "name" identifies the Disaster_Type. Thus in step **114**, SCP **70** sends a TCAP response message having

"Tornado Cat. 3" in the calling name field. SSP **44** prepares to deliver the calling party name to CPE **42** in step **115**, then moves on to step **112**. As described above, in step **112**, SSP **44** transmits the calling party name, together with a date and time stamp to CPE **42** using FSK tone modulation. The disaster warning is displayed on CPE **42** as "Tornado Cat. 3" and subscriber **40** can readily determine that a severe tornado is imminent.

The remaining steps are the same as those described for basic CND above. That is, for subscriber **40**, SSP **44** continues ringing line **43** in step **108**. In step **109**, S-SN **80** issues a call release message to SSP **44** (after waiting the pre-determined wait period), and moves on to the next subscriber (step **104**).

EXAMPLE IV

Subscriber Has Both CND and CNAM

In this example, subscriber **50** has both CND and CNAM services and both services are activated. In step **106** SSP **54** detects that CND is activated on line **53**, and as a result, prepares to deliver the calling number to CPE **52**. In step **111**, SSP **54** detects whether or not line **33** also has CNAM activated. In this case, line **53** has CNAM activated, so SSP **54** moves on to step **113**. Steps **113** through **115** are performed as described in Example III, above. That is a TCAP query is issued to SCP **70** and, in response, the disaster warning message is sent to SSP **54**. In step **112**, SSP **54** transmits the information to CPE **52**. In this case, both the calling party number and the calling party name, together with a date and time stamp are transmitted to CPE **52**. As before, SSP **54** uses FSK tone modulation to transmit the information to CPE **52**. The disaster warning is displayed on CPE **52** as "911-222-333 Tornado Cat. 3" and subscriber **50** can readily determine that a severe tornado is imminent.

The remaining steps are the same as those followed for CND or CNAM services, described in Examples II and III, above. That is, for subscriber **50**, SSP **54** continues ringing line **53** in step **108**. In step **109**, S-SN **80** issues a call release message to SSP **54** (after waiting the pre-determined wait period), and moves on to the next subscriber (step **104**).

Alternate Embodiments

In one alternate embodiment, an extended audible or visible alarm could be implemented by modifying the CPE. In this manner, a specialized CPE could be designed to trigger based on specified CgPNs or CNAMs, which are internally preset or programmed into the CPE. For example, if the CgPN for "Tornado Warning" is 911-222-1111, the CPE would read that number and activate the alarm. In another alternate embodiment, one skilled in the art could modify the CPE to issue a loud audible alarm, a visible alarm such as a flashing light, or a vibrating alarm. The type of sound, vibration, or pattern of flashes could be unique depending on the CgPN, e.g., different sounds or flash patterns could represent different types of warnings. An alarm system as described above is advantageous in that it increases the likelihood that the alarm will be noticed. This modified CPE would work with both basic CND and CNAM service services.

In another alternate embodiment, the need for a TCAP query is eliminated by programming the S-SN to include the disaster warning text in the IAM message itself. Under current AIN standards, IAM messages have a calling party name field which may be used for this purpose. In this embodiment, the disaster warning messages can be transmitted even faster with less load on the systems involved. However, the switch must also be programmed to look for the calling party name in IAM.

The foregoing disclosure of embodiments of the present invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many variations and modifications of the embodiments described herein will be obvious to one of ordinary skill in the art in light of the above disclosure. The scope of the invention is to be defined only by the claims appended hereto, and by their equivalents.

What is claimed is:

1. A method for providing warnings to telephone subscribers in a pre-determined geographic area comprising the steps of:

assigning a first telephone number to a disaster type, wherein the first telephone number corresponds to a specific type of disaster;

receiving information related to a disaster and a target geographic area;

querying a database for a second telephone number having an address within the target geographic area, wherein the second telephone number has a calling number delivery subscription;

sending a call setup message from a specialized service node to a service switching point, wherein the first telephone number corresponds to a specific type of disaster, and is in a calling party field and the second telephone number is in a called party field;

waiting a pre-determined amount of time; and

thereafter, sending a call release message from the specialized service node to the service switching point.

2. The method of claim **1**, further comprising the step of transmitting the first telephone number to a subscriber's customer premises equipment.

3. The method of claim **1**, wherein the second telephone number further has a calling name delivery subscription.

4. The method of claim **3**, further comprising the steps of determining a disaster warning message and transmitting the disaster warning message in a calling party name field to a customer premises equipment.

5. The method of claim **4** wherein the disaster warning message is determined according to the first telephone number using a name database query.

6. The method of claim **4**, wherein the disaster warning message is determined according to a calling name field in the call setup message.

7. The method of claim **1**, wherein the database is resident on the specialized service node.

8. The method of claim **7**, wherein the database is populated with data from a services management system.

9. The method of claim **1**, wherein the specialized service node comprises a computer system and a plurality of data communications links connected to a signaling network.

10. The method of claim **9**, wherein the plurality of data communications links employ Common Channel Signaling System 7 protocol for data communications and the signaling network comprises at least one signaling transfer point.

11. The method of claim **1**, further comprising the step of installing a looped back interface card in the service switching point.

12. The method of claim **11**, further comprising the step of turning off voice path verification for the looped back interface card on the service switching point.

13. The method of claim **1**, wherein the pre-determined amount of time is at least 6 seconds.

14. The method of claim 1, further comprising the step of receiving at the service switching point, a disaster warning message and a geographic area message.

15. The method of claim 14, wherein the disaster warning message and the geographic area message are received from a computer control terminal.

16. The method of claim 15, further comprising the step of selecting the geographic area on the computer control terminal using computer program providing a graphical user interface.

17. A method for providing warnings to telephone subscribers in a pre-determined geographic area comprising the steps of:

(a) assigning a first plurality of telephone numbers to a respective plurality of disaster types, wherein each of the first plurality of telephone numbers corresponds to a specific type of disaster;

(b) populating a database with a second plurality of telephone numbers and a plurality of corresponding addresses;

(c) receiving a message from a control terminal, wherein the message comprises a disaster type and a target geographic area;

(d) querying the database for a third plurality of telephone numbers, wherein the third plurality of telephones are selected from the second plurality of telephone numbers and have addresses within the target geographic area;

(e) sending a call setup message from a specialized service node to a service switching point, wherein the call setup message has a calling party number corresponding to the disaster type and a called party number selected from the third plurality of telephone numbers;

(f) waiting a pre-determined amount of time;

(g) thereafter, sending a call release message from the specialized service node to the service switching point; and

(h) repeating steps (e), (f) and (g) for all telephone numbers in the third plurality of telephone numbers.

18. The method of claim 17, wherein the third plurality of telephone numbers further have a subscription to a calling number delivery service.

19. The method of claim 18, further comprising the step of transmitting the first telephone number to a subscriber's customer premises equipment.

20. The method of claim 17, wherein the third plurality of telephone numbers further have a subscription to a calling name delivery service.

21. The method of claim 20, further comprising the step of transmitting a disaster warning text to a subscriber's customer premises equipment.

22. The method of claim 17, wherein the third plurality of telephone numbers further have a subscription to a calling number delivery service and a subscription to a calling name delivery service.

23. The method of claim 22, further comprising the step of transmitting the first calling party number and a disaster warning text to a subscriber's customer premises equipment.

24. The method of claim 17, wherein the specialized service node comprises a computer system and a plurality of data communications links connected to a signaling network.

25. The method of claim 24, wherein the plurality of data communications links employ Common Channel Signaling System 7 protocol for data communications and the signaling network comprises at least one signaling transfer point.

26. The method of claim 17, wherein the message further comprises a timing parameter.

27. The method of claim 26, further comprising the step of prioritizing the third plurality of telephone numbers according to the timing parameter.

28. The method of claim 17, wherein the pre-determined amount of time is at least 6 seconds.

29. A telephone system providing warnings to telephone subscribers in a pre-determined geographic area comprising:

(a) a specialized service node comprising a database storing a first plurality of telephone numbers and a plurality of corresponding addresses;

(b) a service switching point functionally connected to the specialized service node, comprising a plurality of looped back communications links; and

(c) a plurality of customer premises equipment functionally connected to the service switching point,

wherein the specialized service node receives information related to a disaster in the pre-determined geographic area, and in response to the information, prepares a plurality of call set up messages that include a telephone number corresponding to a disaster type, initiates a plurality of telephone calls to a second plurality of telephone numbers selected from the first plurality of telephone numbers having corresponding addresses within the pre-determined geographic area, and

wherein the specialized service node sends the telephone number corresponding to the disaster type and causes the service switching point to disconnect the plurality of telephone calls after ringing the customer premises equipment at the second plurality of telephone numbers two times.

30. The telephone system of claim 29, wherein the database is populated with a plurality of pre-existing data from a services management system.

31. The telephone system of claim 29, further comprising a control terminal functionally connected to the specialized service node.

32. The telephone system of claim 31, further comprising a communications link using a TCP/IP protocol functionally connecting the control terminal and the specialized service node.

33. The telephone system of claim 31, further comprising a communications link using an Asynchronous Transfer Mode protocol for functionally connecting the control terminal and the specialized service node.

34. The telephone system of claim 29, wherein the plurality of looped back communications links comprise a T1 trunk interface card having a plurality of ports in a loop back configuration.

35. The telephone system of claim 29, further comprising a plurality of analog telephone lines for functionally connecting the service switching point to the plurality of customer premises equipment.

36. The telephone system of claim 29, wherein the plurality of customer premises equipment comprises a means for generating an audible warning.

37. The telephone system of claim 29, wherein the plurality of customer premises equipment comprises a means for generating a visible warning.

38. A telephone system providing warnings to telephone subscribers in a pre-determined geographic area comprising:

(a) a service control point in communication with a signaling network, comprising a first database having a first plurality of telephone numbers assigned to a respective plurality of disaster types;

(b) a specialized service node in communication with the signaling network, comprising a second database having a second plurality of telephone numbers and a plurality of address records;

(c) a specialized service node configured to communicate with a control terminal, wherein the specialized service node receives a message comprising the predetermined geographic area and a disaster type selected from the plurality of disaster types from the control terminal; and

(d) a plurality of service switching points in communication with the signaling network, comprising a plurality of looped back communications links,

wherein the specialized service node initiates a plurality of telephone calls to a third plurality of telephone numbers selected from the second plurality of telephone numbers, wherein the third plurality of telephone numbers have addresses within the predetermined geographic area, and

wherein the specialized service node sends a telephone number, among the first plurality of telephone numbers, corresponding to the disaster type and causes the plurality of service switching points to disconnect the plurality of telephone calls after a pre-determined time period.

39. The telephone system of claim **38**, wherein the signaling network comprises a Common Channel Signal System 7 protocol.

40. The telephone system of claim **38**, wherein the control terminal communicates with the specialized service node using a TCP/IP protocol.

41. The telephone system of claim **38**, wherein the control terminal communicates with the specialized service node using an X.25 protocol.

42. The telephone system of claim **38**, wherein the control terminal communicates with the specialized service node using an ATM protocol.

43. The telephone system of claim **38**, wherein the plurality of looped back communications links comprises looped back ports on a T1 trunk interface card.

44. The telephone system of claim **38**, further comprising a plurality of analog telephone lines functionally connecting the plurality of service switching points to a plurality of customer premises equipment.

45. The telephone system of claim **44**, wherein the plurality of customer premises equipment has means for generating an audible warning.

46. The telephone system of claim **44**, wherein the plurality of customer premises equipment has means for generating a visible warning.

47. In an intelligent switched telecommunications network including a switch, a service control point, a special service node, a first data link functionally connecting the switch and the service control point, and a second data link functionally connecting the special service node and the switch, a method for providing a disaster warning message to a subscriber's calling number delivery system comprising the steps of:

(a) receiving at the special service node a communication from a disaster warning authority, the communication comprising a disaster telephone number and a geographic location, wherein the disaster telephone number corresponds to a specific type of disaster;

(b) selecting a subscriber's telephone number from a database of subscriber addresses, wherein the subscriber's telephone number has an address within the geographic location;

(c) transmitting a call setup message from the special service node to the switch, the call setup message comprising a calling party number and a called party number, wherein the calling party number is the disaster telephone number and the called party number is the subscriber's telephone number;

(d) displaying the disaster telephone number on the subscriber's calling number delivery system; and

(e) transmitting a call release message from the special service node to the switch.

48. The method of claim **47**, further comprising the step of configuring the switch with a plurality of loop-back voice circuits.

49. The method of claim **47**, further comprising the steps of

(f) in response to the call setup message, transmitting a database query message from the switch to the service control point, the database query message comprising the calling party number;

(g) determining at the service control point the disaster warning message by comparing the received calling party number to a second database of disaster telephone numbers;

(h) transmitting the disaster warning message from the service control point to the switch; and

(i) thereafter transmitting the disaster warning message from the switch to the subscriber's calling number delivery system.

50. The method of claim **49**, wherein the step of transmitting the disaster warning message further comprises issuing a sequence of frequency-shift keying tone modulations.

* * * * *

US006369705B1

(12) **United States Patent**
Kennedy

(10) **Patent No.: US 6,369,705 B1**
(45) **Date of Patent: Apr. 9, 2002**

(54) **ALARM MONITORING AND REPORTING SYSTEM**

(75) Inventor: **Thom Kennedy**, 4351 212th Street, Langley, British Columbia (CA), V3A 8C6

(73) Assignee: **Thom Kennedy**, Langley (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/985,376**

(22) Filed: **Dec. 4, 1997**

(51) **Int. Cl.**[7] **G08B 29/00**; G08B 1/03

(52) **U.S. Cl.** **340/506**; 340/539; 340/825.36; 340/825.49

(58) **Field of Search** 340/539, 506, 340/825.49, 825.36, 825.06, 825.47, 10.32, 825.69, 825.72

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,130,801	A	12/1978	Prygoff	455/3.2
4,141,006	A	2/1979	Braxton	340/505
4,625,319	A	11/1986	Krawitz	375/61
4,692,742	A *	9/1987	Raizen et al.	340/539
5,146,612	A	9/1992	Grosjean et al.	455/45
5,153,598	A	10/1992	Alves, Jr.	342/352
5,195,126	A *	3/1993	Carrier et al.	379/45
5,334,974	A	8/1994	Simms et al.	340/990
5,396,647	A	3/1995	Thompson et al.	455/33.2
5,463,672	A	10/1995	Kage	379/59
5,479,482	A	12/1995	Grimes	379/59
5,497,149	A	3/1996	Fast	340/988
5,528,674	A	6/1996	Reiss, III	379/102
5,550,551	A	8/1996	Alesio	342/457
5,559,520	A	9/1996	Barzegar et al.	342/357
5,561,701	A	10/1996	Ichikawa	379/57
5,574,999	A	11/1996	Gropper	455/186.1
5,621,793	A	4/1997	Bednarek et al.	380/20
5,625,363	A	4/1997	Spilker	342/352
5,633,872	A	5/1997	Dinkins	370/312
5,742,233	A *	4/1998	Hoffman et al.	340/573
5,787,429	A *	7/1998	Nikollin, Jr.	340/825.54
5,914,675	A *	6/1999	Tognazzini	340/426
6,084,510	A *	7/2000	Lemelson et al.	340/539

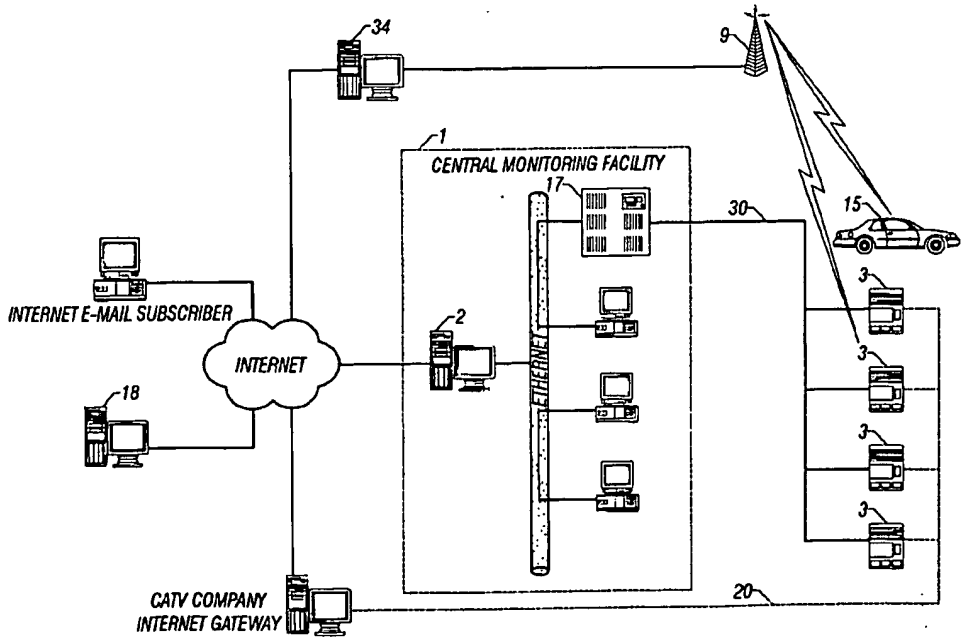
* cited by examiner

Primary Examiner—Donnie L. Crosland
(74) *Attorney, Agent, or Firm*—Michael A. Glenn

(57) **ABSTRACT**

A method and apparatus for monitoring and reporting alarms includes a central monitoring facility which monitors a plurality of remote subscribers. Alarm information is reported to the central monitoring facility by a subscriber. The central monitoring facility causes a summary of the alarm to be transmitted to specific other subscribers. This enables the recipients of the summary to provide follow up reports and to assess how to respond to the report. GPS coordinates are used to identify the location of a reporting subscriber and to select specific other subscribers who should receive the report according to the location of the reporting subscriber.

16 Claims, 3 Drawing Sheets



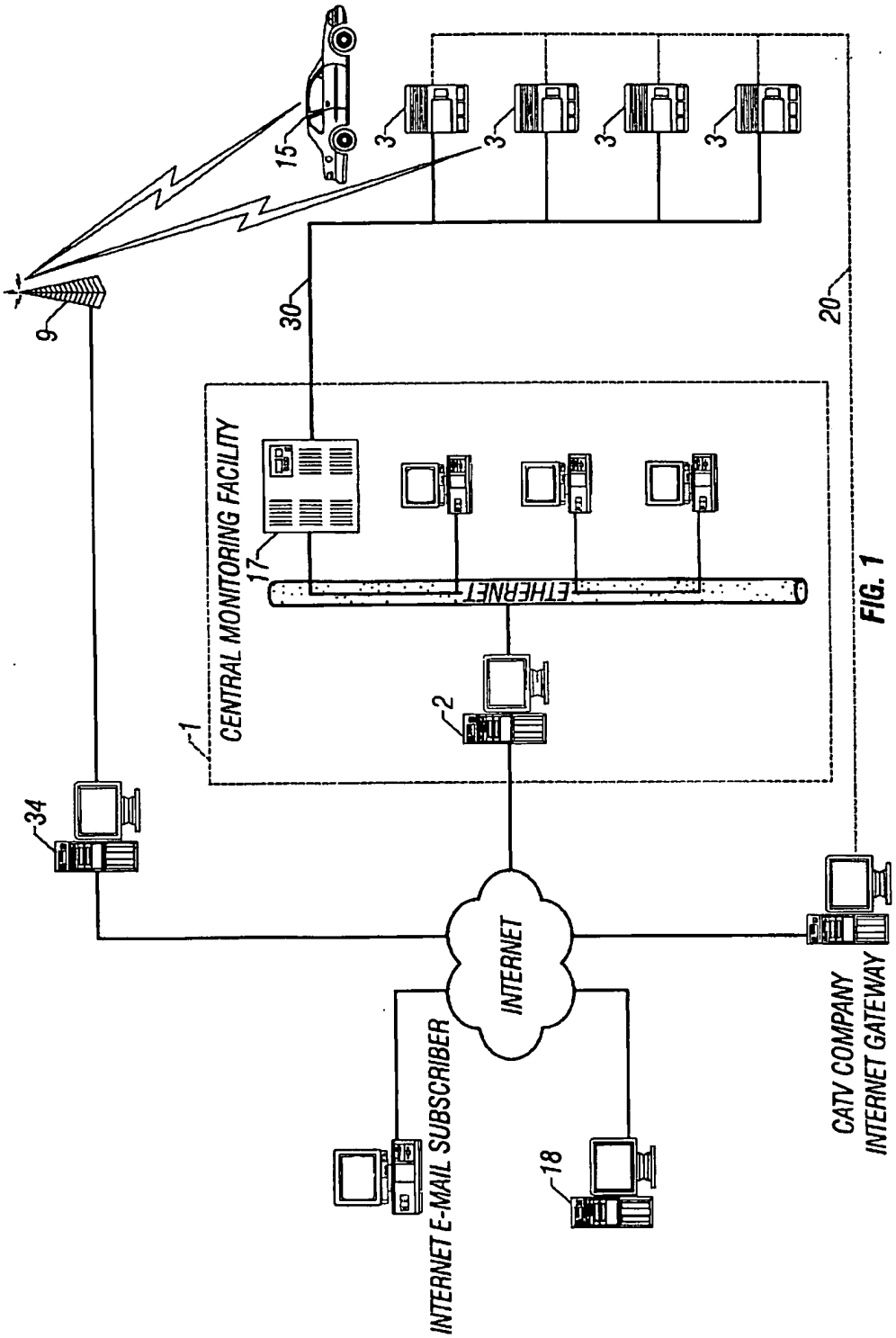

15
3
3
3
3
9
30
20
CENTRAL MONITORING FACILITY
17
ETHERNET
1
2
34
INTERNET
INTERNET E-MAIL SUBSCRIBER
18
CATV COMPANY
INTERNET GATEWAY

FIG. 1

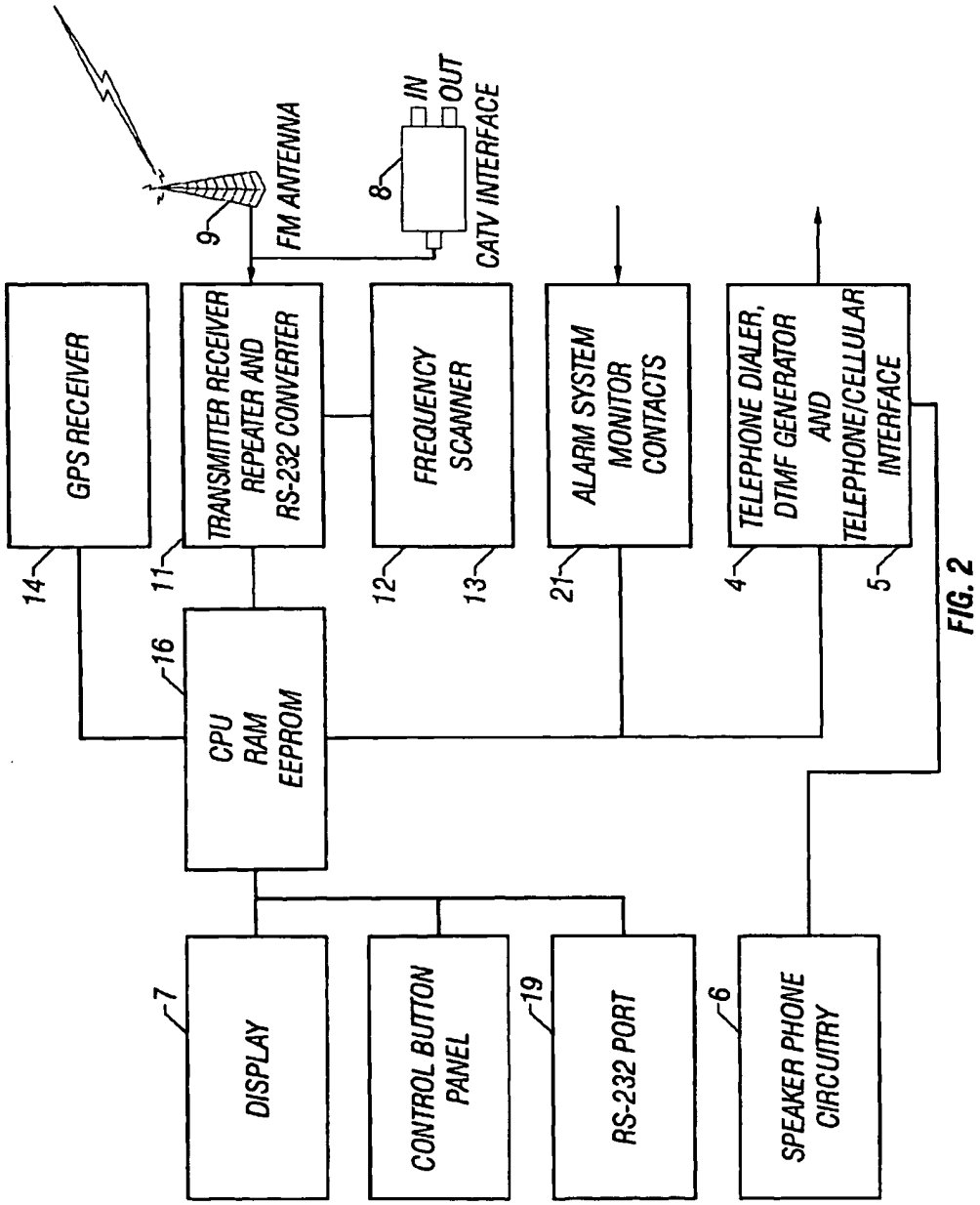

FM ANTENNA
9
IN
OUT
8
CATV INTERFACE
GPS RECEIVER
TRANSMITTER RECEIVER REPEATER AND RS-232 CONVERTER
FREQUENCY SCANNER
ALARM SYSTEM MONITOR CONTACTS
TELEPHONE DIALER, DTMF GENERATOR AND TELEPHONE/CELLULAR INTERFACE
14
11
12
13
21
4
5
16
CPU
RAM
EEPROM
7
DISPLAY
CONTROL BUTTON PANEL
19
RS-232 PORT
6
SPEAKER PHONE CIRCUITRY

FIG. 2

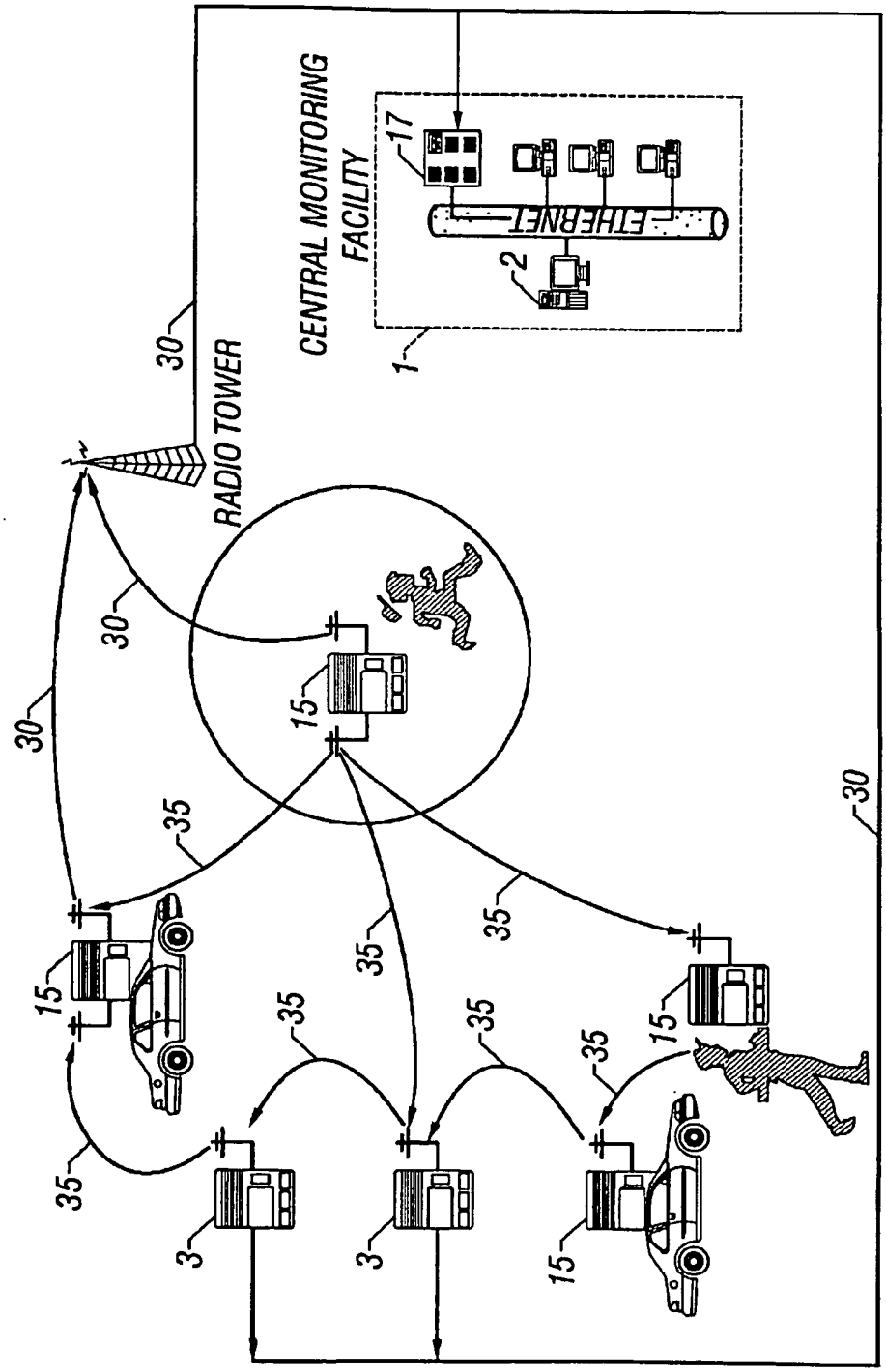

CENTRAL MONITORING FACILITY
17
ETHERNET
2
1
RADIO TOWER
30
15
35
3

FIG. 3

ALARM MONITORING AND REPORTING SYSTEM

TECHNICAL FIELD OF THE INVENTION

This invention relates to an alarm monitoring and alarm report broadcast system. More particularly, this invention relates to a system for centrally monitoring alarm or event reports from a plurality of remote locations and reporting particulars of the alarm to selected others of the monitored remote locations.

BACKGROUND OF THE INVENTION

It is known to provide a central monitoring facility to monitor alarms at a plurality of remote locations. For example, it is common for security companies to monitor the residential or commercial security systems of customers so as to either dispatch security personnel or advise other appropriate authorities upon detection of an alarm. It is also known to provide communication means enabling a central monitoring facility to query an alarm system at a remote location to determine the alarm status. Such a system is described in U.S. Pat. No. 4,141,006 to Braxton.

It is also known to provide a broadcast system for enabling listeners to monitor only the kind of information of interest to the listener. An example of such system is provided in U.S. Pat. No. 5,574,999 to Gropper which describes a system for broadcasting, for example weather reports, which allow the listener to program a digital code into a receiver so that the receiver triggers only in response to specific digital codes broadcast on the monitored radio channel.

In the last few decades, neighborhood based vigilance programs have become common. Such programs encourage individuals within a neighborhood to report or investigate suspicious activity and to thereby enhance the collective security of the community.

Although the prior art approaches referred to above represent significant advancements in collective security systems, they are nonetheless subject to limitations. In the case of the central monitoring of remote alarms, there is necessarily a delay of several minutes or more before ambulance, security or law enforcement personnel reach the alarm location. In the case of neighborhood vigilance programs, an individual witnessing possibly suspicious activity may be reluctant to call in a false alarm, or may assume that someone else in the neighborhood has reported the incident.

The general object of this invention is to provide an improved security system which takes advantage of community involvement in security monitoring, alleviates the disadvantages of existing approaches, enhances the community's ability to pool information regarding alarm conditions and allows concerned individuals other than the individual reporting the alarm to take corrective, protective or helpful action.

SUMMARY OF THE INVENTION

In one of its broad aspects, the invention comprises an alarm monitoring and reporting system wherein a central monitoring facility monitors a plurality of remote subscribers, receives alarm information from one of the subscribers and transmits to specific other subscribers a report of the alarm condition. This enables the recipients of the report to provide further information by providing their own follow-up report, to assess the relative risk presented by the alarm condition and to take protective or helpful action.

In another of its aspects, the invention comprises such a system wherein the subscribers who are to be advised of a given alarm are selected according to the nature of the alarm.

In a further aspect of the invention, the remote alarm locations are identified using GPS coordinates and the GPS coordinates of the alarm reporting location are used as a geographic reference point for determining which other locations are to receive a report of the alarm. Accordingly, those in the immediate vicinity will be able to provide follow up reports regarding the alarm condition, to assess the risk involved and take appropriate action.

In yet a further aspect, the invention comprises such a system which uses an address scheme comprising a component specifically identifying one remote location and a component identifying a group which includes a remote location. In a more specific aspect of the invention, the addressing scheme includes use of the TCP/IP protocol.

In another aspect, the invention comprises apparatus for use in such a system, said apparatus including means for initiating communication with a central monitoring facility and/or other apparatus, communication means for communicating to said central monitoring facility and/or other apparatus information reporting an alarm at the remote location associated with the apparatus, memory means for recording a unique address assigned to the apparatus by the central monitoring facility, transmission means for transmitting to the central monitoring facility and/or other apparatus the unique address and GPS coordinates associated with the apparatus, and alerting means to draw the attention of a subscriber associated with the apparatus.

Other aspects of the invention will be apparent from the claims and from the detailed description of the preferred embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

The invention may be more fully appreciated by reference to the following description of the preferred embodiment, as well as to the claims and the drawings in which:

FIG. 1 is a diagrammatic overview of the alarm monitoring and reporting system of the invention;

FIG. 2 is a block diagram of the components of the subscriber units according to the invention.

FIG. 3 is a diagrammatic overview of the repeating system as used between subscriber units according to the invention.

SYSTEM OVERVIEW

The following is an overview of the invention. Referring to FIG. 1, a central monitoring facility 1 is provided to monitor a plurality of remote locations 3. The central monitoring facility 1 has associated therewith a data base 2.

A plurality of central monitoring facilities, each monitoring a given area, may be provided with the system of the invention. In such case, a system-wide database 18, or a plurality of distributed or associated databases (not shown), may be provided in addition to database 2.

A plurality of subscriber units 3 are installed at remote locations, for example in various homes or businesses in a city. Each subscriber unit 3 includes means 30 for communicating with the central monitoring facility 1. Communication media may include telephone lines, PCS or cellular communication systems, email, cable or any other suitable means and may use Internet or other communication delivery systems. A voice link or other communication channel

between the subscriber unit 3 and the central monitoring facility 1 may be established allowing the subscriber to provide an alarm or event report to one of several operators 32.

Referring to FIG. 3, radio link 35 is also provided to communicate between subscriber units 3 and/or mobile subscriber units 15 within transmission range to provide an alarm report which will be repeated from one subscriber unit to the next until finally reaching the central monitoring facility 1.

At the central monitoring facility 1, a report of the alarm is taken from the subscriber and a decision is made whether the alarm report should be forwarded to a third party agency (not shown), for example a 911 system gateway, a law enforcement agency, a health service provider, etc.

The operator also prepares an alarm report and characterizes the alarm according to predetermined categories. Once the alarm has been categorized, a system-wide or regional database 18 or a local database 2 associated with the central monitoring facility 1 is used to identify which subscribers should receive the report having regard to the kind of alarm involved. One or more digital messages are then broadcast using either dedicated or commercial facilities. In the preferred embodiment, the broadcasts are by radio broadcast through the transmitter 9 of a commercial FM radio station, although it is within the scope of the invention that broadcasts may be by email or other suitable means. The broadcast messages include information identifying which subscribers are targeted by the broadcast. Each of the subscriber units 3 are configured to receive and decode broadcasts in order to determine whether the broadcast targets the subscriber with which the subscriber unit 3 is associated. If so, a variety of visual, audible or other signals may be generated to attract the attention of the subscriber. The digital messages may be tailored according to the level of urgency or pertinence to the subscriber of the alarm in question.

EXAMPLE "A"

The following example "A" will illustrate the operation of the system. Example "A" assumes that several homes in a residential neighborhood are equipped with subscriber units 3 according to the invention. In the example, a subscriber witnesses a break-in at a neighbor's home. The subscriber hits a large alarm button on the subscriber unit to establish a telephone voice link with an operator at the central monitoring facility 1.

As communication is established, the subscriber unit 3 automatically transmits to the central monitoring facility 1 the unit's GPS coordinates, a unique address code assigned to the unit, and a private validation code. Upon receipt of this information, computer means at the central monitoring facility 1 validate the subscriber account then query the database 2 or 18 for other subscriber information which is then displayed to the operator 32. The subscriber provides an oral report of the location of the break-in (e.g., 123 Main Street) and a description of the suspect.

The operator at the monitoring facility prepares an alarm report. The operator also categorizes the alarm according to the pre-established category "In progress—intrusion". Upon doing so, the alarm report and the alarm category are used to determine and identify from the system-wide database 18 those other subscriber units 3 which should receive a report of the break-in.

In the example, the information in the database 18 indicates that "In progress—intrusion" events are to be reported to all subscriber units on the same street as the reporting location, but only if they are within, for example, 500 meters of the reporting unit location. The reporting location is determined from the GPS coordinates downloaded from the reporting unit, or is determined through a database look up based on the unit's unique address downloaded from the unit.

A series of unique addresses for subscriber units 3 within 500 meters of the reporting unit location but which are on Main Street is then extracted from the database. The broadcast processing computer 34 then configures addressing information for targeting a series of broadcast messages to be decoded by the targeted subscriber units. Such addressing information is referred to as "broadcast receive code". One broadcast receive code is configured for each subscriber unit which is to receive a report of the alarm. Each broadcast receive code is then combined with the event report prepared by the operator and with a priority level designation into a message to be broadcast to all subscriber units within the broadcast area served by a commercial FM radio station serving the community in question. Once the message is configured, the broadcast processing computer 34 dispatches the message to an FM transmitter 9 for broadcast.

In the given example, the operator would also contact or put the subscriber in direct contact with a security agency or a law enforcement agency. Where the law enforcement agency is equipped with a subscriber unit, that subscriber unit may be designated as a recipient of all reports for burglaries in progress. Other third party agencies may have the ability to broadcast or access the database on-line, subject to security clearances and pre-authorization.

All operational subscriber units 3 normally monitor the broadcast frequency. When the units on Main Street within 500 meters of the break-in detect that the broadcast receive code is targeting them, they signal the subscriber and display the report on a visual display, e.g. "Burglary in progress, 123 Main St., white male, 5'11", dark brown leather jacket". The nearby subscribers can then observe, take protective action, or provide follow up reports. For example, another neighbor may use a subscriber unit to report that the suspect is now approaching the window at 125 Main Street and a corresponding follow up report can be submitted to the central monitoring facility, and a follow up broadcast may be initiated. In another scenario, another subscriber may report that the suspect is now heading west down a particular alley in a brown sedan with a given license plate number.

It will therefore be appreciated that this invention provides an opportunity for a level of interactivity and vigilance in community security which allows better and more immediate information and alerting to alarm conditions.

In the foregoing example, the system-wide database 18 stored information defining the selection criteria for reporting each type of alarm or event. However, it is within the scope of the invention that the selection criteria be stored in memory means such as a local database 2 associated with the central monitoring facility. In one such embodiment, the operator may make decisions on a case by case basis, in each case selecting a geographic area or radius or other parameter defining who should be notified with an event report. Such criteria may then be dispatched (along with the event report itself) to the broadcast processing computer 34 to identify those specific subscribers meeting the criteria, to define broadcast receive codes to target such subscribers, and to configure the messages to be broadcast.

In another embodiment, the computer associated with the central monitoring facility 1 may go so far as to output a

precise set of GPS coordinates. The coordinates alone are then dispatched to the broadcast processing computer **34** and are used to configure the broadcast receive code using the unique addresses for subscribers within the coordinates as recorded in the system-wide database **18**.

EXAMPLE "B"

The following example "B" will illustrate the operation of the system when used in a mobile environment. Although the same procedures and practices are used as in example "A", this example "B" expands upon one specific feature of the invention not demonstrated within example "A".

Example "B" assumes that several homes, automobiles and pedestrians in a residential neighborhood are equipped with subscriber units **3** according to the invention. In the example "B", a child subscriber is in the process of being abducted and is carrying a mobile subscriber unit **15**. The child subscriber hits a large alarm button on the mobile subscriber unit **15** to establish a telephone voice link with an operator at the central monitoring facility **1**. The mobile subscriber unit **15** now attempts to establish a cellular or PCS connection with the central monitoring facility **1**. Simultaneously, the mobile subscriber unit **15** broadcasts a radio distress transmission **35** to activate automatic repeaters **11** in nearby subscriber units **3** and nearby mobile subscriber units **15**.

These nearby subscriber units **3** and mobile subscriber units **15** now attempt to communicate with the central monitoring facility **1** via their primary communication technique **30** and also simultaneously broadcast a radio distress transmission **35** to activate automatic repeaters in nearby subscriber units **3** and nearby mobile subscriber units **15**.

This radio broadcast and repeating **35** provides a redundant backup for should the primary communication **30** fail and provides coverage in areas not serviced by the primary communication system **30** such as in underground parking.

The invention will now be described in more detail.

Subscriber Unit

Referring to FIGS. **1** and **2**, each subscriber unit includes communication means for establishing communication with the central monitoring facility. Typically, such communication will be through the public switched telephone network and will be by DTMF signaling and oral. However, it is within the scope of the invention that such communication be by any other means, such as through the Internet, email, a cellular telephone network, PCS, 2-way paging, by radio or through a two way communication link **20** using a pre-existing cable or cable television network.

In the preferred embodiment, the medium of communication from subscriber units **3** to the central monitoring facility **1** is through the public switched telephone network. Referring more specifically to FIG. **2**, the subscriber unit **3** includes telephone jacks and an automatic dialer **5** for dialing the central monitoring facility **1** when a call is initiated by pressing a large alarm button on the subscriber unit **3**.

The subscriber **3** unit includes a speaker phone **6** for enabling hands free oral communication between the subscriber and the operator at the central monitoring facility **1**, a visual display **7** for displaying alarm reports, an audible alarm for drawing the attention of the subscriber, a flashing light display, and a keyboard to allow the subscriber to enter information. The unit further includes CATV ports **8** and an RS-232 serial port **19** for connection to serial devices. In the preferred embodiment, the unit also includes a swipe slot for receiving credit cards, debit cards or other cards for recording financial transactions, and a text to speech algorithm for audio playback of text messages for visually impaired subscribers.

The subscriber unit **3** further includes a receiver, which in the preferred embodiment is an FM receiver **10** for receiving FM sideband broadcasts, an integral FM antenna **11**, a frequency scanner **12** and a digital filter **13**.

A GPS receiver **14** is incorporated into the subscriber unit **3** for use in initializing the unit at a subscriber location and for active use in mobile subscriber units **15**. A CPU **16** is provided to control the operation of the subscriber unit **3**.

Initialization of the subscriber unit **3** at a subscriber location so as to become subscribed to be monitored and to be able to provide reports of events is as follows. After the unit power is turned on, the CPU defaults to a subroutine to determine whether the unit has previously been initialized or needs to be re-initialized. If not, it undertakes an initialization program including written instructions which appear on the visual display **7** to direct the subscriber to initialize the unit.

The first instruction is for the subscriber to place the unit is an outside area and to turn on a GPS receiver switch on the unit, and to leave the unit in this mode for a predetermined period of time. Upon activation of the GPS receiver switch, the GPS receiver waits (if necessary) and will acquire GPS coordinates once the appropriate GPS satellite signals have been received. The GPS coordinates are loaded into memory and the subscriber is alerted to the completion of this phase of the initialization process.

The subscriber is then directed to install the unit in its intended location in the subscriber's premises. The system then asks the subscriber to input through the keyboard information regarding the subscriber. This may include information such as the residential or commercial address, health information, employees of the business or members of the household, emergency contact numbers, valuable items information, information as to pets, routing instructions for alarm reports and any other information which may be useful. This may further include socio-demographic or political information. The subscriber may have an option as to what information is provided.

The subscriber will also be queried to indicate preferences as to the types and times of reports the subscriber wishes to be alerted to. Accordingly, the subscriber may choose not to be alerted to certain incoming reports. In the preferred embodiment, the central monitoring facility **1** retains the option of overriding such subscriber preferences for certain priority levels of alarm reports.

The subscriber is also asked to input the contact telephone number of the central monitoring facility **1**. Such number may be provided as a list of numbers according to geographic areas. The number is stored for use in association with the automatic dialer **5**.

When all pertinent information has been collected, the subscriber is directed to test the unit by hitting the alarm button. Doing so triggers the automatic dialer **5** to dial the telephone number of the central monitoring facility **1**. Upon establishing an open telephone line with the central monitoring facility, the unit transmits a code indicating that the transmission is pursuant to a unit initialization, and including the GPS location for the unit. The unit also transmits the subscriber inputted information in encrypted form for recording in the database **2** associated with the central monitoring facility and in the system-wide database **18**. The central monitoring facility will query the system-wide database **18** to assign a unique address to the subscriber unit **3** and will transmit to the subscriber unit **3** through the telephone line or other communication channel being used:

the unique address for the unit

one or more FM frequencies for use by the unit's digital frequency scanner 12

a list of general group address codes to which the unit is authorized to respond

The selection of FM frequencies to be transmitted is based on the GPS coordinates received from the subscriber unit 3. The general group address codes are determined based on predetermined criteria to enable general addressing of broadcasts to a plurality of subscriber units 3. In certain cases general group broadcasts rather than individually targeted broadcasts provide more efficient broadcasting. Alternatively, the subscriber may subscribe to topical broadcasts, for example sports, weather or financial news in which case a general group broadcast may also be appropriate.

The subscriber unit 3 then stores the unique address, the FM frequencies, and the general broadcast codes, sets the FM receiver 10 to active mode and disconnects the telephone line.

The subscriber is then required to hit the alarm button once again and to inform the operator at the central monitoring facility 1 that the subscriber is testing the unit. The following steps also occur in normal operation. When the alarm button is pressed, the automatic dialer 5 dials the central monitoring facility 1. Upon establishing an open telephone line or other communication channel, the unit transmits the unique address, a private validation code and the GPS location. Once the unique address, validation code and GPS location are correlated and validated by the central monitoring facility 1, a DTMF or other code is sent to the subscriber unit 3 to activate the input devices to enable communication with the operator. Typically such devices will include a speaker phone for oral communication. The operator at the central monitoring facility 1 then orients the subscriber to the use of the unit and to the protocol for alarm reports. Once this is done, the operator triggers a test broadcast targeting the specific subscriber unit 3.

The digital frequency scanner 12 in the subscriber unit scans the several FM frequencies previously indicated by the central monitoring facility and a filter 13 filters the signal to detect a digital signature packet identifying the signal as one associated with the system of the invention. The digital signature packet is transmitted at timed intervals, e.g. every 10 seconds. If the digital signature packet is detected, the scanner 12 selects that frequency for monitoring by the receiver. If the filter 13 fails to detect the digital signature packet for 10 consecutive intervals, the scanner 12 begins once again scanning the several FM frequencies in order to acquire another signal. If no proper signal can be located and locked, the subscriber unit 3 causes an audible alarm and a written message to be displayed to alert the subscriber to the lack of signal.

Assuming a proper signal is detected and locked on during the initialization test, the subscriber unit 3 will receive a test broadcast including a broadcast receive code containing the unique address allocated to the subscriber unit and a welcoming message to the subscriber. The unit's filter 13 will detect the presence of the unique address identifying the unit and will enable an audible alarm on the unit. The presence of the unique address in the broadcast receive code also enables the display of the transmitted message to the subscriber's visual display 7.

The subscriber confirms to the operator that the welcoming message has been received and the initialization is then complete. In normal operation, the welcoming message is replaced by an event or alarm report.

In normal use, where several reports are received, they can be sorted and displayed based on various criteria such as time and date of receipt, priority level or other such criteria at the election of the subscriber.

Central Monitoring Facility

The operation of the central monitoring facility 1 will now be described.

The central monitoring facility 1 includes a PBX 17 or similar system for handling a plurality of incoming telephone calls and routing them to operators. A computer telephony integration system is associated with the PBX.

A computer 38 and a database 2 are associated with the central monitoring facility. The database 2 may be remote from the facility and may be a distributed database which is accessed through the Internet, and may be shared by a number of central monitoring facilities and with the system-wide database 18. The database stores system level information and subscriber specific information.

The system level information in the database includes:

information regarding participating FM radio stations for various areas across the system, and their respective frequencies;

(optionally) selection criteria for which subscribers should receive particular types of alarm reports

the TCP/IP addresses of related databases across the system for national or wider area broadcasts

emergency categories of reports which will override the subscriber's stipulation not to receive reports, and associated priority level designations for broadcasts

general group broadcast codes

The subscriber specific information maintained in the database includes:

security access controls such as the private validation codes of subscriber units

whether the subscriber unit is a fixed or mobile unit

its normal GPS location in the case of fixed subscriber units

subscriber identifying information

subscriber characteristics, including health, employees, family, etc.

emergency contact information

a correlation of the unique address with the GPS coordinates

neighborhood identifying information

account information

Communications from subscriber units 3 to the central monitoring facility 1 include the transmission of the GPS coordinates of the unit, a unique address assigned to the unit, and a private validation code assigned to the unit. Upon receipt of the unique address, a computer integrated telephony system verifies the unique address and code to ensure that it represents the subscriber's account and that the account is valid. If the account verification fails, the PBX generates a DTMF signal to request a retransmission of the address and code from the subscriber unit. If verification is successful, an oral communication link with an operator is established and a recording unit begins recording the conversation. Simultaneously, the database 2 or 18 is accessed and the name and a synopsis of the subscriber is displayed to the operator's screen monitor.

The operator will take an oral alarm report from the subscriber and will enter pertinent event detail information into the database including a characterization of the nature of the event. As the event detail is inputted, an incident number is assigned to the report. The operator may elect to

immediately connect the subscriber by voice to a third party agency and may either continue or discontinue direct communication with the subscriber. The operator may then input a request for a broadcast and a priority level to be used for the broadcast. The broadcast processing computer **34** receives the broadcast request, queries the database **2** or **18** and compiles one or more messages each of which includes the report, the priority level assigned to the broadcast and a broadcast receive code. The broadcast receive code may include the unique address of the subscriber intended to be targeted by the broadcast report, and/or GPS coordinates within which subscribers are to be alerted.

Typically, alarms will be of interest to other subscribers in the immediate vicinity of the reporting subscriber and the subscriber may be taken as the bull's eye of a general target area for the broadcast of an alarm report. In such case, the database **2** is consulted to associate the reporting subscriber unit with its geographic location (if GPS coordinates were not included in the transmission from the reporting unit to the central monitoring facility), and to identify the unique addresses of all other subscriber units within the reporting selection criteria and within the geographic area of concern. However the geographic area of concern is not limited to a strict radius from the reporting location and will often be an irregular area.

For example, a report of a rabid raccoon may be of particular interest to subscribers who own dogs, particularly within a certain radius of the reporting unit. Alarms of burglaries in progress will be of interest to all subscribers within a certain radius but perhaps only for contiguous streets. Reports of underground supply line gas leaks may be of interest only to anyone along the gas line within a certain radius.

The priority level designations maintained in the database **2** or **18** are used to flag a broadcast as being one which may override a certain level of restrictions on reports which are stipulated by the subscriber in the subscriber unit.

Addressing Scheme and Transmission

The database **2** or **18** is therefore used to retrieve a collection of unique addresses according to geographic parameters for subscriber units to be targeted by a report broadcast, as defined by the central monitoring facility or as pre-defined according to selection criteria maintained either at the central monitoring facility or in the system-wide database **18** or inputted on a case by case basis by a human operator.

The unique addresses are configured to include elements identifying the subscriber as being within general classes (geographic or otherwise) and to also identify the unique subscriber. The elements identifying the subscriber as being within general classes allows the creation in appropriate cases of shorter broadcast receive codes thereby reducing the opportunity for the introduction of errors or noise in the transmission process. The preferred embodiment of the invention uses the TCP/IP protocol for the unique addresses. The protocol provides for the use of subnet addresses which may be assigned to subscribers according to the general class in which the subscriber falls. Thus, it is possible to broadcast using only a subnet addressing scheme so as to effectively target all subscribers within a broadcast area who fall within the general class. In such case, the database maintains information associating the TCP/IP address for each subscriber with the subscriber's GPS address and associating the subscriber with the appropriate subnet addresses which cover the subscriber.

A broadcast receive code may therefore be directed to subscribers by class to which they belong, or by designating individually a subscriber unit which is targeted to receive the broadcast.

Upon receipt of the target TCP/IP addresses from the database, the most efficient addressing scheme available based on the collection of targeted TCP/IP addresses and available subnet addresses is determined. Where individual targeting of subscribers is deemed necessary because no subnet addresses are appropriate, the broadcast processing computer will configure a series of broadcast receive codes each of which includes a single TCP/IP address targeting a single subscriber unit. Each broadcast receive code also includes GPS coordinates identifying a geographic zone. Where it is intended that the subscriber units should display the report to the subscriber based on only TCP/IP address matches, the GPS coordinates are set as a default code which is interpreted by the subscriber units as indicating that GPS coordinates are not to be used by the unit in determining whether to display the report. In such cases the subscriber units will look to the TCP/IP address or to subnet address matches to determine whether the unit is targeted by the broadcast. Similarly in cases where all subscriber units within a given area are to display the report, the TCP/IP portion of the broadcast receive code may be set to a default value indicating that the GPS parameters or the subnet address is to be examined to determine whether the unit is targeted. This scheme allows targeting either by GPS location (i.e., within an area mapped by the transmitted GPS coordinates) by TCP/IP address (designating a particular subscriber unit) or by subnet address (for group broadcasts).

Each broadcast receive code is then combined with a descriptor of the FM transmitter to be used, the level of priority of the report, an incident report number and with the report itself into a message and instructions to the transmitter to broadcast, all of which is dispatched by the broadcast processing computer **34** to the transmitter **9**. The messages are routed to the appropriate FM transmitter according to the transmitter descriptor. In the preferred embodiment, the FM transmitter **9** is a commercial FM radio station transmitter and transmission is by FM sideband.

Each message is then transmitted to the FM transmitter's broadcast coverage area. The subscriber units receive the message, filter it to detect the broadcast receive code, analyze the broadcast receive code to determine whether the unit is targeted. This is done by determining whether the code includes either the unit's specific TCP/IP address, or a set of GPS coordinates within which the unit falls (by reference to the unit's GPS coordinates acquired upon unit initialization or which are being regularly updated in the case of mobile units) or a subnet address from among those downloaded into the unit upon initialization. If so, a conclusion is made that the unit is targeted by the broadcast.

In such case, the priority level of the broadcast is extracted from the message. The priority level determines to what extent the subscriber may elect to suppress the display of the report on the subscriber unit. In some cases, the highest priority levels will override any restrictions imposed by the subscriber on the display of the report in question. In other cases, lower priority levels allow varying degrees of subscriber imposed restrictions. The CPU will then determine the subscriber set preferences as stored in the unit's memory upon initialization or as later modified by the subscriber. A decision is then made based on the subscriber preferences and the priority level of the broadcast whether to display the report and how the report will be displayed, i.e. flashing screen or light only, audible alarm, etc.

When a subscriber makes a follow up report based on previously received report, the subscriber calls up the event report on the screen of the unit. The CPU notes the incident number of the original report and will include such number

in the identification package which is dispatched to the central monitoring facility upon establishing a communication channel for the purposes of the follow up report. This allows the database and the operator to correlate the follow up with the original report.

It will be appreciated that the means of communication specified for the preferred embodiment are illustrative only. For example, it is within the scope of the invention for the subscriber units, the central monitoring facility, the databases, third party agencies and the transmitter to communicate with one another through WAVE facilities provided on the local cable television infrastructure, by radio, microwave, telephone, etc. Appropriate input and output ports are provided on the equipment to enable such communication.

Although the preferred embodiment of the invention specified oral communication between the subscribers and the central monitoring facility, the subscriber units may also be connected to a building security system or other security systems for automated rather than oral reports to the central monitoring facility. The subscriber unit is accordingly provided with alarm system monitor contacts.

Mobile Subscriber Units—Including Vehicular and Portable Mobile Units

In the case of mobile subscriber units **15**, the initialization of the unit occurs in the same manner as for the stationary subscriber units described above. In normal monitoring operation, the GPS receiver in the unit is kept on and regularly feeds the GPS coordinates to the CPU **16** of the unit.

It will be appreciated that if a mobile unit is not within range of the transmitter used for a given broadcast, the unit will simply not receive the message. If the unit is within range, the unit will undergo an identical process as for the stationary units as described above. The broadcast receive code will be examined to determine whether the code includes the TCP/IP address of the unit, or the unit is within the GPS coordinates included in the code, if any, or if the subnet address included in the code matches one of those stored in the unit's memory.

It will be appreciated by persons skilled in the art that certain variations on the preferred embodiment may be practiced without departing from the scope of the invention.

What is claimed is:

1. A method for monitoring and disseminating event reports from a plurality of monitored remote locations, comprising the steps of:

subscribing said plurality of monitored remote locations to be monitored by a central monitoring facility and to report to said central monitoring facility alarm conditions at said monitored remote locations;

providing said central monitoring facility for monitoring event reports from said subscribed plurality of monitored remote locations;

receiving a communication from a reporting one of said monitored remote locations, said communication providing a report of an event at said reporting location;

said central monitoring facility communicating said event report for reception and decoding by at least a plurality of said monitored remote locations other than said reporting location, said plurality of monitored remote locations being configured to decode said event report according to the geographic proximity of said monitored remote locations to said reporting location.

2. A method as in claim **1** wherein said plurality of monitored remote locations is selected by the central monitoring facility according to the nature of the event.

3. A method as in claim **2** wherein the step of selecting comprises the steps of:

an operator at said central monitoring facility characterizing the nature of the event; and,

consulting a database which identifies the plurality of monitored remote locations which should receive said event report based on the nature of the event and the geographic proximity of said monitored remote locations to said reporting location.

4. A method as in claim **1** wherein each of said remote locations are identified using GPS coordinates and the GPS coordinates of said reporting location are used as a geographic reference point for selecting which of said monitored remote locations are to receive said event report.

5. A method as in claim **4** further including the steps of:

associating each of said remote locations with an address code;

the central monitoring facility causing a transmission of said event report in association with a plurality of said address codes.

6. A method as in claim **5** wherein said transmission is by radio.

7. A method according to anyone of the preceding claims wherein said event is an emergency.

8. A method as in claim **5** further comprising the step of:

causing apparatus associated with at least one of said remote locations to monitor said transmission for the presence of an address code associated with said apparatus.

9. A method as in claim **5** wherein said address code is based on the TCP/IP protocol.

10. A method as in claim **4** further including the steps of:

associating each of said remote locations with an address code;

the central monitoring facility causing a transmission of said alarm report in association with at least one set of GPS coordinates.

11. A method as in claim **10** wherein said transmission is by radio.

12. A method as in claim **5** further comprising the step of:

causing apparatus associated with at least one of said remote locations to monitor said transmission for the presence of GPS coordinates within which said apparatus is located.

13. A method as in claim **5** wherein said transmission is by Internet.

14. A method as in claim **5** wherein said transmission is by telephone.

15. A method according to any one of claim **1**, **2**, **3**, **4**, **5**, or **6** wherein at least one of said remote locations is a mobile location.

16. A method according to any one of the claim **1**, **2**, **3**, **4**, **5**, or **6** wherein said apparatus includes means for receiving and repeating a broadcast from another said apparatus.

* * * * *